

Draft Report

Residential Retrofit Contract Group First Draft Verification Report

Prepared for:
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1. Executive Summary

This executive summary provides information about the study's purpose and discusses high-priority measures, primary findings, and results. It also presents, in table format, the reported and verified savings by utility, program, and measure.

This document is a verification report of the 2006 and 2007 program cycle for the California Residential Retrofit programs. California's Investor Owned Utilities (IOUs) Pacific Gas & Electric (PG&E), Southern California Edison (SCE), San Diego Gas & Electric (SDG&E), and Southern California Gas (SCG) each implemented the Residential Retrofit programs in their respective service territories. This verification of the 2006 and 2007 program is a study mandated by the California Public Utility Commission (CPUC). The Cadmus Group, Inc. served as the prime contractor. Additional contractors included: Itron, Jai J. Mitchell, Kema, and PA Consulting.

Background

The Residential Retrofit Evaluation Team verified the savings from energy efficiency programs offered by each of IOUs in California that target residential retrofit and replacement between January 1, 2006, and December 31, 2007. These 25 programs include: those offering rebates to consumers for the purchase of high efficiency equipment such as room air conditioners, water heaters, and furnaces; programs educating consumers about the benefits of efficient products and/or behaviors; programs offering manufacturers incentives that reduce the retail sales prices of equipment (such as Compact Fluorescent Bulbs) in the state; and programs that motivate residences to replace or repair inefficient equipment and/or install new efficient products. Some of these programs offer rebates primarily to residential customers but are also available to small commercial customers. Residential programs that are exclusively marketing, education, outreach or information are being evaluated in separate contract groups.

Purpose and Objectives

The objectives of the verification were to confirm the installations claimed by the IOUs, to corroborate that appropriate *ex ante* assumptions were used and documented in the claims, and to validate the calculations used for those claims. The purpose of the verification report is to provide a high quality, reliable and objective verification of claimed program accomplishments from residential retrofit energy efficiency programs run in the state of California. This estimate of impacts will contribute to the final evaluation report, which will impact decisions on the cost effectiveness of the programs, as well as contribute to the decision making process regarding the verifiability and accuracy of the earnings claims by the IOUs in California. As such, this study may serve as a resource in the final decisions by the CPUC on the size of the payments made to, or penalties levied against, the IOUs.

Impact evaluations and related verification reports serve many purposes including improving the programs, supporting the cost-effectiveness analyses, providing data for future programs and strategic planning, and helping to determine share-holder incentives/penalties in California. With finite resources, the plans have been developed to reflect the highest priority uses of evaluation,

which involve providing adjustments to the gross savings claimed by the utilities, the net savings after accounting for free-ridership (generally through self-reported surveys), and information essential to valuing the savings, such as the annual load shapes of the savings.

Because many of the above priorities are best met by producing data at the measure or end use level, the Residential Retrofit Evaluation Team focused on the most important, high-impact measures in the current portfolio, as well as those projected to be important in the future portfolios. This involved focusing the limited evaluation resources on detailed end use-level field data collection.

Table ES-1. Summary of Residential Retrofit Key Measure Efforts for First Verification Report

Programs with Key Measures	Measure/End-Use	Sector/Area	No. Telephone Surveys	No. Site Visits
PGE2000 ARP	Recycle Refrigerator	Residential/Small commercial	247	NA
PGE2000 ARP	Recycle Freezer	Residential/Small commercial	94	NA
PGE2000 Upstream Lighting	Upstream Res/C&I Exterior lighting fixtures; Upstream Res/C&I Interior lighting fixtures; Upstream Res/C&I Interior screw-in lighting	Residential/Small commercial	326	NA
PGE2000 HVAC	Duct Sealing	Residential	NA	178
PGE2000 HVAC	Refrigerant Charge and Airflow	Residential	NA	115
PGE2000 MF	Res Interior Lighting Fixtures	Residential	NA	71
PGE2000 MF	Res Exterior Lighting Fixtures	Residential	NA	56
PGE 2000 SF	Dishwashers	Residential	197	33
PGE 2000 SF	Room Air Conditioners	Residential	91	10
PGE 2000 SF	Clothes Washers	Residential	215	37
PGE 2000 SF	Water Heaters	Residential	82	10
PGE 2000 SF	Pool Pumps	Residential	78	10
PGE 2000 SF	Furnaces	Residential	173	35
PGE 2000 SF	Wall insulation	Residential	46	14
PGE 2000 SF	Ceiling (attic) insulation	Residential	139	27
SCE2500 ARP	Recycle Refrigerator	Residential/Small commercial	232	NA
SCE2500 ARP	Recycle Freezer	Residential/Small commercial	89	NA
SCE2501 Res	Whole House Fans	Residential	157	NA
SCE2501 Res	Evaporative Coolers	Residential	172	NA

Programs with Key Measures	Measure/End-Use	Sector/ Area	No. Telephone Surveys	No. Site Visits
SCE2501 Res	Room Air Conditioner	Residential	426	NA
SCE2501 Res	Lighting Exchange	Residential	136	NA
SCE2501 Upstream Lighting	Upstream Res/C&I Interior screw-in lighting; Upstream Res Exterior lighting fixtures; Upstream Res Interior lighting fixtures	Residential/Small commercial	309	NA
SCE2502 CMMHP	Duct Test and Seal	Residential	90	35
SCE2502 CMMHP	AC Diagnostic	Residential	150	54
SCE2502 MF	Res Exterior Lighting Fixtures	Residential	NA	62
SCE2502 MF	Res Interior Lighting Fixtures	Residential	NA	70
SCG3510 MF	Res Water Heater Controls	Residential	NA	43
SCG3517 Res	Attic Insulation	Residential	196	37
SCG3517 Res	Wall Insulation	Residential	153	36
SCG3517 Res	Dishwasher	Residential	110	43
SCG3517 Res	Clothes Washer	Residential	114	28
SDGE3016 Upstream Lighting	Upstream Res Exterior lighting fixtures; Upstream Res Interior lighting fixtures; Upstream Res Interior screw-in lighting	Residential/Small commercial	146	NA
SDGE3017 MF	Res Interior Lighting Fixtures	Residential	NA	70
SDGE3017 MF	Res Interior Screw-in Lighting	Residential	NA	57
SDGE3017 MF	Res Water Heating	Residential	NA	52
SDGE3017 MF	Res Water Heating Controllers	Residential	NA	6
SDGE3028 ARP	Recycle Refrigerator	Residential/Small commercial	234	NA
SDGE3028 ARP	Recycle Freezer	Residential/Small commercial	82	NA
SDGE3035 CMMHP	Duct Test and Seal	Residential	82	43
SDGE3035 CMMHP	AC Diagnostic	Residential	137	68
SDGE3024 Res	Pool pump Single-Speed	Residential	131	18
SDGE3024 Res	Pool pump Multi-Speed	Residential	30	14
SDGE3024 Res	Pool pump Reset	Residential	179	15
Total	NA	NA	5,043	1,347

2. Overall Purpose and Approach of the Verification Report Effort

This document contains verification findings for the CPUC-designated, high-impact program/measure groups for the Residential Retrofit evaluation contract group. Those program/measure combinations selected for verification efforts across all contract groups represent approximately 85 percent of all IOU savings claims for 2006–2007. For this contract group, a variety of measures across eleven programs are subject to verification.

This document contains verification findings for the following programs:

- PGE2000 Residential Mass Market*
- SCE2500 Appliance Recycling
- SCE2501 Residential Incentive*
- SCE2502 Multifamily*
- SCE2502 Comprehensive Manufactured/Mobile Home program*
- SCG3510 Multifamily*
- SCG3517 Single family Rebate*
- SDGE3016 Upstream Lighting
- SDGE3017 Multifamily Rebate*
- SDGE3028 Appliance Recycling
- SDGE3035 Mobile Home*
- SDGE3024 Residential Incentive*

*Only select measures within these programs are subject to verification

2.1. Verification Goals

The purpose of this first verification report is to: verify actual installation rates of portfolio level, high-impact program/measure combinations; review the reasonableness of utility-filed claimed values and algorithms; and gather additional information whenever possible to inform the evaluation report.

The verification includes two efforts:

1. This first verification effort, which verifies the accomplishments of all high-impact program/measures combinations during 2006 and 2007.
2. The second effort, to be completed in 2009, which will verify all high-impact program/measures combinations achievements during 2008.

2.2. Evaluation Priorities

As part of its effort to efficiently allocate verification and evaluation resources and to generate statistically significant and meaningful results at both the program and utility portfolio-level, the CPUC identified a list of key program/measure combinations contributing heavily to total demand and energy savings and serving as the focus of the verification efforts.

Given all program/measure combinations discussed in this document and identified as high-impact, all survey and site visits sample sizes have been generated to yield results at a minimum of 10 percent precision with 90 percent confidence. In fact, many of the samples exceed this requirement, providing results at 5 percent precision with 90 percent confidence or greater.

2.3. Participant and Non-Participant Designations

Unless otherwise specified, the verification defines participants as the end-user.

2.4. Reliability

This verification effort seeks to meet the CPUC's stated objective of obtaining reliable estimates of net coincident peak demand reduction and annual energy savings generated by the designed high-impact program measure groups. Reasonably accurate and precise estimates can be considered reliable as they minimize the potential for each of the following types of error:

- **Measured:** This may be caused by inaccurate equipment or human error. The Residential Evaluation Team intends to use the most accurate (within budgetary constraints) metering equipment, and every reasonable effort will be made to identify and minimize the potential for measurement error. As very little measurement will be implemented as part of the verification effort, this is an unlikely cause for concern within this initial work.
- **Collected:** Specifically, non-response error occurs when some portion(s) of the population proves less likely than other portions to provide data. Investments that increase the response rate, such as incentives and multiple contact attempts, address non-response errors and will be used as needed in individual programs.
 - **Described (modeled):** When statistical models create estimates, errors may occur due to use of inappropriate functional forms, inclusion of irrelevant explanatory variables, and so on. When using statistical models, potential errors will be investigated and, when suspected, steps taken will be taken to eliminate them.
- **Random Error:** Using sampling rather than census modeling can create random errors; any sample can be drawn from a population with a large number of possible samples of the same size and design. The Residential Evaluation Team will design all samples to meet or exceed required confidence and precision levels.

2.5. Upstream Lighting Program Methodology

There were two primary areas of focus for the Upstream Lighting Program verification effort:

- Verify assumptions regarding the percentage of rebated lighting products that are installed in residential versus nonresidential applications (that is, the “residential/nonresidential split”), and
- Verify the quantity of lighting products that were installed by end-use customers.

Verification of Residential/Nonresidential Split

SCE assumed that 90 percent of the screw-in CFLs rebated through the Upstream Lighting Program will be installed in residential applications and 10 percent will be installed in nonresidential applications. PG&E assumed that 90 percent of all of the lighting products rebated through the Upstream Lighting Program will be installed in residential applications and 10 percent will be installed in nonresidential applications. As such, these utilities assigned residential per-unit savings values to 90 percent of the rebated units, and nonresidential per-unit savings values to 10 percent of the rebated units. SDG&E assumed that 100 percent of the rebated units would be installed in residential applications and therefore used only residential per-unit savings values for their program.

All three utilities assumptions regarding the residential/nonresidential split are being verified as part of the overall evaluation effort for the Upstream Lighting Program. For this verification report, we reviewed the utilities’ work papers regarding the sources for these assumptions and considered additional information available from other sources. However, at this time, we do not have enough reliable information in order to verify the accuracy of the utilities assumptions regarding the residential/nonresidential split.

A more comprehensive assessment of these assumptions is being conducted as part of the ongoing evaluation effort for the Upstream Lighting Program. This effort will draw on the results of the following data collection activities:

- In-store intercepts are being conducted to identify purchasers of rebated CFLs who intend to install the products in nonresidential applications.
- Surveys with manufacturers and participating retailers are being conducted to obtain their best estimates of the volume of rebated CFLs that will eventually be installed in nonresidential applications.
- Surveys with both residential and nonresidential end-use customers to estimate the volume of CFLs purchased through retail locations that will eventually be installed in nonresidential applications.
- Surveys with commercial property managers to determine the volume of CFLs purchased through retail locations that are eventually installed in leased properties.
- Surveys with lighting and electrical contractors to assess the volume of CFLs purchased through retail locations that are eventually installed in nonresidential applications.

This evaluation research is being coordinated between the Residential Retrofit and Small Commercial Evaluation Contract Groups.

Verification of Measure Installation Rate

Given the upstream nature of this program, it is not possible to survey a sample of participants and determine whether or not the rebated measures are installed and operational. Instead, we can only assess – across the residential and nonresidential populations – the percent of CFLs that are purchased and installed within a specific period of time.

As part of the ongoing evaluation of the Upstream Lighting Program, we are developing an estimate of the distribution of time-to-installation for CFLs rebated during 2006-2008. We are using data from CFL user telephone surveys to develop relationships among bulb acquisition, installation and storage rates, and to develop a profile of household CFL usage patterns. This survey is being conducted in waves (every 3 months for 5 quarters, with the first wave completed in June 2008) and will produce a total sample of 1,500 CFL users. The results from this first wave of the CFL user telephone survey have been used to develop a preliminary estimate of a residential installation rate for the Upstream Lighting Program. We will update this estimate once the evaluation effort is completed.

We are coordinating with the Small Commercial EM&V Contract Group to assess installation rates for CFLs rebated through the Upstream Lighting Program and installed in non-residential applications.

3. Program-Specific Findings

3.1. PGE2000 Appliance Recycling Program

Program Overview

The Appliance Recycling program (ARP) seeks to produce cost-effective, long-term, coincident peak demand reduction and annual energy savings in residential and nonresidential market sectors by removing operable, inefficient, primary and secondary refrigerators, freezers, and room air conditioners from the power grid in an environmentally safe manner.

To stimulate participation, ARP offers incentives for eligible refrigerators (\$35), freezers (\$35), and room air conditioners (\$25). In addition, ARP collaborates with other utility programs such as the Residential Energy Efficiency Incentive program and Multifamily Energy Efficiency Rebate program. These programs help encourage ARP participants to replace retired units with ENERGY STAR[®]-qualified refrigerators, freezers, and room air conditioners.

The 2006–2008 program included two significant changes to previous program iterations:

- adding room air conditioners and
- expanding eligibility to include small commercial businesses.

The ARP added room air conditioners at the suggestion of the Program Advisory Group (PAG), based on market saturation and potential for additional cost-effective, long-term, coincident peak demand reduction, and long-term, annual energy savings. The addition of room air conditioners complements the existing ARP portfolio and supplements the ENERGY STAR[®]-qualified room air conditioner rebate offered through other utility programs. Implementation of room air conditioners follows the best practice model established through the Keep Cool Bounty program of New York State Energy Research and Development Authority (NYSERDA).

Also, as a number of office complexes and industrial buildings have standard, residential-size refrigerators and freezers, the PAG recommended expanding the 2006-2008 ARP. In response, the program now offers incentives to select nonresidential customers, including office complexes, industrial customers, schools, and municipalities.

The CPUC and project team evaluators determined that two of the three measures (refrigerator and freezer recycling) of the PGE2000 program are high-impact program measure groups for the PGE verification effort. Program achievements reported through Q4 2007 for these two high-impact measures are presented in Table 1, on the following page.

Table 1. PGE2000 Program Claims (2006-2007)¹

Measure Description	Quantity
Recycle Refrigerator	57,749
Recycle Freezer	10,702

Installation Verification Sampling and Methodology

Verification Priorities

As noted above, two of the three ARP customer-rebated measures were considered high-impact combinations: refrigerator and freezer recycling. Consequently, data collection for the verification of these measures was based upon sample sizes selected to yield verification results with 10-percent precision at the 90-percent confidence level at the program level and a research and data collection design to minimize any potential biases. No site visits were conducted as part of this verification effort.

Participant Surveys

To verify program-incented measure removal, the phone survey was based upon a randomly selected sample of program participants and stratified by program measure. Participants who had an older refrigerator and freezer recycled were asked questions regarding:

- whether the unit was removed from their home,
- the program's role in the decision to remove the unit,
- the usage patterns of the removed appliance, and
- participation in other related PG&E programs.²

Table 2 presents the sample size and stratification of the telephone surveys.

Table 2. PGE2000 Sample Sizes

Measure	Participants* (Through 4Q 2007)	Telephone Surveys	Site Visits
Recycle Refrigerator	56,292	247	NA
Recycle Freezer	10,670	94	NA

*Note participants are defined as households, not recycled units

¹ per Q4 2007 E3 Calculator.

² The first of these is the inquiry used for the verification analyses. The others will be used for the impact evaluation.

Installation Results

Table 3 and Table 4 present results from telephone surveys for recycled refrigerators and freezers. Telephone survey results for both recycled refrigerators and freezers revealed that all program measures were removed, for a verification rate of 100 percent.

Table 3. PGE2000 Verification Findings for Recycled Refrigerators

	Phone Survey (N=247)	On-site Survey* (N=0)	Total Survey Adjustment**
% of units confirmed as removed	100.0% (247)	NA	100.0%
% of units not confirmed as removed	0.0% (0)	NA	NA

*No site visits conducted, recognizing that a site visits provides no greater accuracy as it is not possible to confirm on-site that a unit was previously there and then removed.

**Realization rate is the product of the % of units currently installed/operable/operable from the phone survey and the on-site surveys

Table 4. PGE2000 Verification Findings for Recycled Freezers

	Phone Survey (N=94)	On-site Survey* (N=0)	Total Survey Adjustment**
% of units confirmed as removed	100.0% (94)	NA	100.0%
% of units not confirmed as removed	0.0% (0)	NA	NA

*No site visits conducted, recognizing that a site visits provides no greater accuracy as it is not possible to confirm on-site that a unit was previously there and then removed.

**Realization rate is the product of the % of units currently installed/operable/operable from the phone survey and the on-site surveys

3.2. PGE2000 Upstream Lighting Program

Program Overview

PG&E's Mass Markets Program targets the combined segments of single-family and multifamily residential retrofit, commercial and residential renters, and commercial customers who often lack information, time, and resources for energy-efficiency projects. The Mass Markets Program uses both PG&E and third-party specialists to facilitate delivery of a portfolio of energy-efficiency, demand-response, and distributed-generation services. It includes statewide elements as well as elements specially targeted to the mass market customers in PG&E's service area. The Mass Markets Program also includes programs partnered with local and state governments that provide outreach and marketing, and direct installation for single family and multifamily residences and small businesses in their jurisdictions. In addition, the program integrates a number of third party components, including those targeting specific customer segments and end-use technologies.

The Upstream Lighting Program is a key component within PG&E's overall Mass Markets Program. It provides manufacturer and distributor buy-downs or retailer instant discounts for eligible lighting products that are then sold to mass market customers through participating retailers. In the Mass Markets Program Implementation Plan (PIP), PG&E states that its overall goals for the Upstream Lighting component are to continue to work with manufacturers to improve CFL performance (form, fit, efficacy, life, and power quality) and to add more products to address a variety of lamp sockets. PG&E also intends to work with manufacturers and retailers to speed market transformation of new and emerging efficient lighting technologies, and to increase penetration in existing and new markets for more traditional lighting solutions.

PG&E's program tracking database does not provide sufficient descriptive measure information to determine if these goals are being met. As shown in Table 5, about 89 percent of the units rebated and 93 percent of the rebates paid have been for CFLs, and the measure name does not distinguish the more traditional, bent-tube/twister-style CFLs from the more advanced or specialty CFL products (reflector-style, globe or A-lamp style, dimmable or three-way features, etc.). We have evidence that PG&E is promoting these types of specialty bulbs, but are unable to determine to what extent they are being rebated through the program because of this lack of detailed information.

During 2006-2007, PG&E provided nearly \$50 million in rebates to participating manufacturers and retailers. Rebate levels varied by product type and promotional strategy. The overall average rebate paid for lighting products distributed through the Upstream Lighting Program during 2006-2007 is \$1.58.

Table 5. Lighting Products and Rebates Paid through PGE2000/PGE2080 Upstream Lighting Program (2006-2007)

Type of Lighting Product	Units Rebated				Rebates Paid				Min Rebate Paid	Max Rebate Paid
	PGE2000	PGE2080	Total	Percent of Units Rebated	PGE2000	PGE2080	Total	Percent of Rebates Paid		
Exterior fixtures	100,229	10,547	110,776	0.4%	\$1,002,290	\$105,470	\$1,107,760	2.3%	\$10.00	\$10.00
Interior fixtures	112,121	11,706	123,827	0.4%	\$1,121,210	\$117,060	\$1,238,270	2.6%	\$10.00	\$10.00
LED products (holiday lights, night lights)	2,737,088	298,696	3,035,784	10.1%	\$654,465	\$72,261	\$726,726	1.5%	\$0.02	\$1.25
T8 lamp replacement	0	135,458	135,458	0.4%	\$0	\$145,733	\$145,733	0.3%	\$1.00	\$1.50
CFLs	24,140,166	2,648,198	26,788,364	88.7%	\$40,125,056	\$4,405,176	\$44,530,232	93.3%	\$0.35	\$3.50
Totals	27,089,604	3,104,605	30,194,209		\$42,903,021	\$4,845,700	\$47,748,721			

The CPUC and project team evaluators determined that all of the measures rebated through PG&E's Upstream Lighting Program, including the residential and nonresidential measures, are high-impact program measures for the PG&E verification effort. Table 5 presents program achievements reported through Q4 2007.

Verification Methodology

All of the measure groups included in the PGE2000 and PGE2080 Upstream Lighting Program are considered high-impact. Table 6 describes the data collection effort and sample sizes undertaken for the verification.

Table 6. PGE2000/PGE2080 Upstream Lighting Program Verification Sample Sizes

Verification Objective	Data Collection Activity	Sample Size
Verify res/nonres split	Review best available data	NA
Verify residential screw-in measure installation rate	CFL User Telephone Survey	781 / 326 (PG&E)
Verify residential fixture measure installation rate	Review best available information	NA
Verify C&I screw-in measure installation rate	Review best available information	NA
Verify C&I fixture measure installation rate	Review best available information	NA

Verification of Residential/Nonresidential Split

PG&E claimed that 10 percent of the lighting products rebated through the Upstream Lighting Program would be installed in nonresidential applications. Therefore, PG&E assigned 10 percent of the measures and per-unit savings values to the nonresidential PGE2080 program ID and 90 percent to the residential PGE2000 program ID.

The residential/nonresidential split assumption will be fully evaluated as part of the overall evaluation effort for the Upstream Lighting Program. The team is conducting in-store intercepts to identify purchasers of rebated CFLs who intend to install the products in nonresidential applications. In addition, we are conducting surveys with manufacturers and participating retailers to obtain their best estimates of the volume of rebated CFLs that eventually is installed in nonresidential applications. The team also is surveying both residential and nonresidential end-use customers to estimate the volume of CFLs purchased through retail locations that eventually are installed in nonresidential applications. The Residential Retrofit Evaluation Team is conducting surveys with property managers to determine the volume of CFLs purchased through retail locations that are eventually installed in leased properties. Finally, we also are conducting surveys with lighting and electrical contractors to assess the volume of CFLs purchased through retail locations that are eventually installed in nonresidential applications. This evaluation research is being coordinated between the Residential Retrofit and Small Commercial Evaluation Contract Groups.

Given that this evaluation research is ongoing, this first Verification Report relied on a review of the best available information to verify the residential/nonresidential split assumed for the Upstream Lighting Program. The results of this review are discussed later in this chapter.

Verification of Measure Installation Rate

PG&E assumes a 76-percent in-service rate for the screw-in CFLs rebated through the Upstream Lighting Program for both residential and nonresidential applications. PG&E assumes a 100-percent in-service rate for CFL fixtures (exterior and interior, residential and nonresidential).

As part of the overall evaluation of the Upstream Lighting Program, we will develop an estimate of the distribution of time-to-installation for CFLs rebated during 2006-2008 and installed in residential applications. We will also use data from CFL user telephone surveys to develop relationships among bulb acquisition, installation and storage rates, and to develop a profile of household CFL usage patterns. The survey will be conducted in waves (every 3 months for 5 quarters, starting in June 2008 and ending in June 2009) and will produce a total sample of 1,500 CFL users. We will rely on CFL survey data being collected by the Small Commercial Contract Group to assess installation rates for screw-in CFLs installed in nonresidential applications.

The evaluation will also address installation rates for interior and exterior lighting fixtures installed in residential and non-residential fixtures.

Since only the first wave of the CFL user telephone survey has been completed, we relied on a review of the best available information to verify PG&E's assumed 76-percent residential in-service rate for the Upstream Lighting Program. We also reviewed the best available information to verify PG&E's assumed 76-percent in-service rate for non-residential screw-in CFLs and the assume 100-percent in-service rates for lighting fixtures installed in interior and exterior, residential and non-residential applications.

We discuss the results of this review of best available information and the recommended installation rate below.

Installation Results

Table 7 summarizes the results from verification activities completed for the Upstream Lighting Program, followed by a discussion of the assessment conducted for each verification objective.

Table 7. PGE2000/PGE2080 Upstream Lighting Program Verification Findings

Verification Objective	Data Collection Activity	Verification Result
Verify res/nonres split	Review best available data	Inconclusive
Verify residential screw-in measure installation rate	CFL User Telephone Survey	67% in-service rate (PG&E assumed 76%)
Verify residential fixture measure installation rate	Review best available information	100% (PG&E assumed 100%)
Verify C&I screw-in measure installation rate	Review best available information	67% (PG&E assumed 76%)
Verify C&I fixture measure installation rate	Review best available information	100% (PG&E assumed 100%)

Verification of Residential/Nonresidential Split

As mentioned above, PG&E assumed that 90 percent of the lighting products rebated through the Upstream Lighting Program would be installed in residential applications and 10 percent would

be installed in nonresidential applications. However, PG&E's work papers provide no justification or rationale for their assumptions.

SCE work papers provided justification for these assumptions by citing a study it completed in 1994. Based on survey responses, SCE determined that between 12 percent and 19 percent of CFLs purchased through the program were installed in nonresidential applications. SCE used this result to set a conservative 10 percent target for the 2006-2008 Upstream Lighting Program.

Other sources of information related to the residential/nonresidential split include:

- End-use customer surveys completed in support of the 2004-2005 Express Efficiency and Single Family Rebate (SFR) Program Evaluations suggest that less than 10 percent of customers purchase CFLs from retail locations and go on to install them in nonresidential applications.
 - The commercial customer surveys completed for the evaluation of the 2004-2005 Express Efficiency Program indicated that less than 3 percent of commercial customers purchase CFLs from retailers for installation in their place of business.
 - The residential customer surveys completed for the evaluation of the 2004-2005 SFR Program indicated that 7 percent of residential customers purchase CFLs from retailers that eventually get installed in nonresidential applications.
- This result is consistent with the findings from the first wave of the CFL User telephone survey conducted as part of the evaluation of the 2006-2008 Upstream Lighting Program. In this most recent survey (completed in June 2008), residential customers indicated that 7 percent of the CFLs purchased at retail locations were eventually installed in nonresidential applications.
- Finally, PG&E and SCE 2006-2008 Upstream Lighting Program process evaluation findings which, based on retail store manager self-reported estimates, suggest that between 14 percent and 22 percent of CFLs purchased from participating retailers are installed in nonresidential applications.

At this time, we do not have enough reliable information to verify the accuracy of the utilities assumptions regarding the residential/nonresidential split. As discussed above, the residential/nonresidential split assumption will be further examined as part of the evaluation of the 2006-2008 Upstream Lighting Program.

Verification of Measure Installation Rate

Residential Screw-In CFL Installation Rate

Our primary source of evidence for estimating residential in-service rates for screw-in CFLs purchased through the 2006-2008 Upstream Lighting Program is the first wave of the CFL User

telephone survey conducted in June 2008.^{3[1]} The results of this survey indicate that 67 percent of CFLs purchased between January 2006 and June 2008 are installed and 24 percent are in storage. The rest either burned out, broke, were given away, or installed but later removed, as shown in Table 16. This table also shows that 51 percent of CFLs purchased between April and June 2008 are installed and 47 percent are in storage.

Table 8. Summary of Evidence for Upstream Lighting Program Installation Rates

	April - June 2008		Between January 2006 - June 2008	
Number of respondents who purchased CFLs	118		344	
Average number of CFLs purchased (among purchasers)	10		13	
Average number of CFLs purchased (among all households)	2		6	
Total quantity of CFLs purchased	1,189		4,430	
- installed at primary residence or another residence located within IOU service territory	612	51%	2,958	67%
- stored at primary residence or another residence located within IOU service territory	563	47%	1,070	24%
- burned out	7	1%	217	5%
- given away	0	0%	79	2%
- installed but later removed (uncertain if being stored or not)	0	0%	59	1%
- broke	7	1%	35	1%
- returned	0	0%	12	0%
- misplaced	0	0%	0	0%
- installed in another residential location outside of IOU service territory	2	0%	0	0%
In-Service Rate	51%		67%	
- includes installs at primary residence and other locations within IOU service territory				
- excludes dk and refused responses				

When all waves of CFL user telephone survey have been completed, the Residential Retrofit Evaluation team will analyze the residential in-service rate applicable to the 2006-2008 program and adjust the results accordingly. This final evaluation residential screw-in installation rate result will be based upon 1,500 CFL User surveys completed across 5 survey waves and an econometric-based CFL acquisition, installation, storage model.

^{3[1]} The CFL user telephone survey is expected to provide data that will be used to estimate the distribution of time-to-installation for CFLs. Data from these surveys will also be used to develop econometric-based estimates of relationships among bulb acquisition, installation and storage rates, and develop a profile of household CFL usage patterns. Conducted in waves (*i.e.*, every 3 months for 5 quarters, starting in June 2008 and ending in June 2009), this survey will produce a total sample of 1,500 CFL users

Residential Lighting Fixture Installation Rate

PG&E assumes 100 percent of the residential lighting fixtures rebated through the Upstream Lighting Program are installed and operational. This is consistent with most programs offering rebates for residential lighting fixtures. However, we did not find any studies or other research that could verify these assumptions. For the time being, we accept PG&E's 100 percent installation rate for residential lighting fixtures. We will assess this assumption further as part of the ongoing evaluation effort.

C&I Screw-In CFL Measure Installation Rate

As mentioned above, PG&E assumes that the in-service rate for screw-in CFLs rebated through the Upstream Lighting Program is the same for both residential and nonresidential applications. At this time, we assume the same in-service rate for residential CFLs rebated through the Upstream Lighting Program also applies to nonresidential CFLs. This assumption will be verified as part of the ongoing evaluation through surveys with nonresidential customers, property management and maintenance companies, contractors and other lighting vendors.

C&I Lighting Fixture Installation Rate

PG&E assumes 100 percent of the nonresidential lighting fixtures rebated through the Upstream Lighting Program are installed and operational. This is consistent with most programs offering rebates for nonresidential lighting fixtures. However, we did not find any studies or other research that could verify these assumptions. For the time being, we accept PG&E's 100 percent installation rate for nonresidential lighting fixtures. We will assess this assumption further as part of the ongoing evaluation effort.

3.3. PGE2000 HVAC Incentive Program

Program Overview

The HVAC measures implemented in PGE2000 target the HVAC service and replacement market for residential and small commercial customers. The program provides incentives based on the degree of improvement in HVAC system performance. Each system is tested as part of the intake process, and deficiencies identified. The deficiencies are addressed, and the system is then tested again to ensure proper performance. The program pays a smaller incentive to customers whose systems show no deficiencies in the pre-test and does not claim any savings for those systems. The program also encourages quality installation of system replacements, both for replacements on burnout and for early replacement of units identified as deficient in the testing process.

The HVAC program operates through verification service providers (VSP), which provide incentives to HVAC contractors. The contractors can use the incentive they receive to provide their services free of charge to customers, or they may choose to charge customers for some portion of the service cost. Each VSP is required to adhere to standards established by PG&E, though a variety of different refrigerant charge and airflow test methods are used in the field by the different VSPs.

Specific measures included in the program are Residential Duct Sealing and Residential Refrigerant Charge and Airflow Testing and Adjustment. Table 9 shows the program's achievements for these two measures through Q4 2007. PG&E has assigned three different values to the duct sealing measures, all of which appear in the table.

Table 9: PGE2000 HVAC Program Claims (2006-2007)⁴

Measure Description	Quantity
Residential Duct Sealing	25,622
Duct Test and Seal	5,915
Test Out Seal – Level I	17,877
Test Out Seal – Level II	1,830
Refrigerant Charge and Airflow	54,638

Each of the PGE2000 HVAC high-impact measure programs provide incentives to contractors to perform initial tests and if necessary additional incentives to repair residential duct leakage and the refrigerant charge and airflow of air conditioning systems. The PG&E2000 Duct Sealing program is marketed through utility bill inserts, the PG&E Web site, and other advertisements.

⁴ per Q4 2007 E3 Calculator.

The program requires participants to be located in Climate Zones 2, 4, 11, 12, or 13. It also requires that homes have existing or replaced air conditioners or heat pumps. Individual systems must be between 1.5 and 7 tons cooling capacity and multiple systems at the same address are eligible.

If the initial duct leakage test result is less than 15 percent of fan flow then no repairs are required and no incentive will be provided. The rebate can be up to \$600, but the actual rebate amounts are based on a variety of factors, including age of the air conditioning system and the system's Seasonal Energy Efficiency Rating (SEER).

The refrigerant charge and airflow program is marketed through individual contractors and the incentives can vary from free service to partial payments. PG&E only refers customers to call upon California licensed air conditioning contractors (C20) to have system checkups and detail the benefits of necessary repairs. Systems that do not pass a diagnostic test do not receive rebates.

Installation Verification Sampling and Methodology

Verification Priorities

The CPUC has identified this program's HVAC measures as high-impact measures because they accounted for 6.4 percent of expected demand (kW) savings for PG&E programs for the 2006 and 2007 program years. The duct sealing measure also represents 1.2 percent of PG&E's total therm savings.

While the Residential Retrofit Evaluation team is also conducting participant surveys to assess net savings, telephone verification is insufficient for these HVAC maintenance measures. These measures are not a piece of equipment that can be verified on-site from a simple visual inspection. Instead, verification was conducted through site visits that included tests to determine the performance of the duct seals, as well as refrigerant operating conditions and system airflow.

Participant On-Sites

The Residential Retrofit Evaluation team selected its on-site verification sample to achieve ideal precision at the measure level and to sample heavily in the climate zones with the most savings. The PGE2000 HVAC measures are weather-dependent, and the highest savings per unit and greatest activity level are in climate zones 12 and 13. The sample sizes in Table 10 represent the sites that have been visited for which data has been processed.

Table 10. PGE2000 HVAC Verification Sample Sizes

Measure	Participants (Through 4Q 2007)	Site Visits*
Duct Sealing	25,622	208
Refrigerant Charge and Airflow	54,638	150

Verification Methodology

For the purpose of verification we must specify a pass-fail criterion for duct system performance and the refrigerant charge metrics, subcooling and superheat.

Duct Sealing

PG&E provides rebates only when duct sealing occurs on existing, new or replacement units and measured leakage is 15 percent of nominal fan flow or better. The on-site verification procedure includes both total leakage and leakage to outside tests. The ultimate passing of a unit is first analyzed as total leakage at 25Pa being less than 15 percent of nominal fan flow, calculated as 400 cfm/nominal ton. In addition, if the leakage to outside at a house pressure of 25Pa is less than 10 percent of nominal system fan flow it will be considered passing.

Refrigerant Charge and Airflow

Correct refrigerant charge is determined by measuring the amount of subcooling in the condenser for air conditioning units with a thermostatic expansion valve (TXV) and the amount of superheat in the evaporator for those with fixed orifice metering. These measured values are then compared to targets as determined by the manufacturer or the operating conditions. Typically, manufacturers publish subcooling targets for units manufactured after 1992. The majority of units manufactured before this date are not equipped with TXVs, for those that are, a standard target of 10°F can be used. Superheat targets are calculated from Table RT-2 (in the 2005 Residential ACM Approval Manual) using measured return air wet bulb and condenser entering air dry bulb temperatures.

The program, Title 24, and industry standard procedures are consistent for the criteria on fixed orifice metering devices. For systems with TXV, the program allows an uncertainty of plus or minus five degrees of subcooling relative to target, while industry standard, Title 24, and the verification team require plus or minus three degrees subcooling. Target superheat or subcooling values are obtained from manufacturer's data or calculated from the 2005 Residential ACM Approval Manual and compared to actual values.⁵ The units were also further analyzed using all data available, including the measured cooling output, using the airflow temperature and humidity measurements. If units did not pass the subcooling or superheat test, but were within plus or minus ten degrees of the target and also were operating close to manufacturer reported performance conditions, the unit was treated as passing.

Under conditions when the superheat target is near zero, the system is operating with a dry coil, which was somewhat common. For these units, the team also looked at the subcooling of the unit with a target of 10°F. Units that had a reasonable but failing value for superheat that passed the subcooling test were treated as passing.

⁵ See Appendix D for more detail regarding the procedure for calculating actual subcooling and superheat.

The program requires airflow verification similar to Title 24 using the temperature split method.. The method essentially verifies that flow is greater than 350cfm/ton for a large percentage of units based on empirical data. In addition, the verification effort utilized direct flow measurements using an orifice plate flow grid and digital manometer.

The flow measurement has an accuracy of plus or minus seven percent under ideal installation conditions. Therefore, the criteria are expanded to accommodate the measurement accuracy to 325 cfm/ton. In addition, most non-ideal flow measurement installations favor the measurement low. For units where the first option for installation was unfeasible in the field, the criterion was additionally lowered to 300 cfm/ton. If a unit failed direct flow measurement, but passed the temperature split method it was considered failing for airflow and was also noted as a false positive. Units where the direct flow measurement was not possible were judged based on the temperature split method and if they passed were also subject to the false positive adjustment.

The refrigerant charge and the system airflow were equally weighted in determining the final unit disposition. Units were scored from 0 to 100 with each test worth 50 points. A unit passing both tests was scored 100 and units that failed one test but passed the other were scored 50. A unit that passed the temperature split airflow test and that had an indeterminate direct flow measurement was subject to the false positive adjustment and was scored 33 out of 50.

Uncertainty Analysis

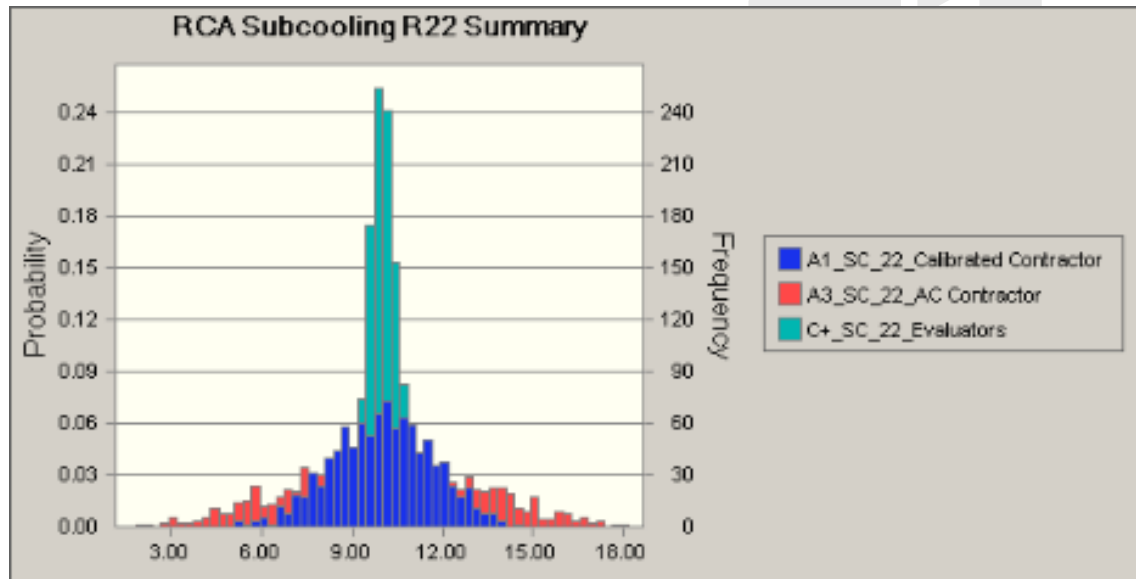
The current procedure for CPUC RCA verification includes measurements of operating conditions collected by contractors and also includes instantaneous direct airflow and power measurements. The verification assessment also checks to see if refrigerant leaks are present which would rapidly degrade measure savings. The instrumentation suites for verification are manufactured and calibrated to tighter tolerances than those being used by contractors in the field. This reduction in instrumentation uncertainty should produce an independent and more accurate assessment of the appropriateness of refrigerant charge applications made by the contractors. The program evaluators ran Monte Carlo simulations to explore engineering propagation of error of the various instrumentation components required to assess superheat and subcooling which was used to inform the need and selection of improved instrumentation suites.

Essential to this study was the accuracy of the instruments used for typical refrigerant charge and airflow testing including superheat and subcooling tests. To that effect both the accuracy levels and instrument costs of several models were compared. The models of the instruments tested included calibrated instruments used by the contractors and those eventually chosen for use in the study (the evaluator). In each case it was determined that the accuracy of the instruments used by the evaluator for this study far exceeded that of the contractors.

Figure 1 shows an example of these analyses for a system with R-22 refrigerant and TXV metering device. The Figure shows that the Evaluators' instrumentation suite is more likely to achieve the target of 10 degrees subcooling than instrumentation that is typically used by AC

contractors and VSPs. Similar engineering propagation of error analyses were performed for PG&E by an independent third party engineer and those reports were made available to the team and have similar conclusions.⁶

**Figure 1: Monte Carlo Simulation Results for Various Instrumentation Precisions:
Air Conditioner with TXV and R-22 Refrigerant**



Site Visit Details

Visual inspections are insufficient to verify that HVAC performance measures have been installed properly and are capable of producing the desired energy savings.⁷ Some methods of duct sealing leave visual evidence and those are investigated in the field but especially for the refrigerant charge measures, inspection is impossible. The verification procedures for duct sealing and RCA require similar performance diagnostic tests as those used by program implementing contractors. The verification techniques were designed to go beyond the techniques used by implementers to provide greater certainty in the measurements and to best understand energy implications of the verification results. The performance tests include additional techniques, procedures, and carefully selected precision instrumentation, all of which are presented in Appendix D.

⁶ The reports are not referenced directly in this report because the papers are not available to the public.

⁷ Verification requires that the measure is installed/adopted/accomplished and is operable/capable of producing the anticipated savings. The later evaluation effort requires estimation of energy and demand savings achieved. The methods established and conducted for this verification effort will support both.

Installation Results

The following tables present results from on-site surveys for duct sealing and refrigerant charge and airflow. The Residential Retrofit Evaluation team also analyzed contractor data, where available for the sample, to compare results.

The duct leakage tests revealed a relatively high failure rate. Sites with either total leakage less than fifteen percent or leakage to outside less than ten percent passed the test (53 percent of sites). In addition, many sites where the data were in question would likely have failed the tests. Table 11 presents the results of on-site verifications based on the methodology outlined for passing or failing. The indeterminate sites were predominantly those without unit nameplates and odd configurations that could not hold the test pressure. The average leakage for each group and the pass rate are weighted up to the population by climate zone.

Table 11. PGE2000 HVAC Duct Sealing Verification Findings

Test Outcome	On-site Survey (n)	Average Total Leakage	Average Leakage to Outside	Pass / Fail Rate
PASS	105	11%	7%	53%
FAIL	87	28%	20%	47%
DK	16	-	-	-

There are certain multifamily situations with supply ducts between apartments that present little opportunity for savings. There were sixteen of these sites in the sample; ten passed and six failed. These sites are included in the final adjustment.

The refrigerant charge and airflow tests also revealed a relatively high failure rate. Both the temperature split and flow grid measurements revealed roughly half the units with adequate flow and several with low airflow. The superheat test was used to assess systems with fixed refrigerant metering devices and the subcooling test units with thermal expansion valves (TXV), which revealed that half the units passed. For many sites with failing flow, the superheat test can be indeterminate. Table 12 presents the results of on-site verifications based on the methodology outlined for passing or failing airflow and charge tests.

Table 12. PGE2000 HVAC Refrigerant Charge and Airflow Verification Findings

Test Outcome	Airflow On-Site Survey (n)	Pass Measured AIRFLOW	Pass Temperature Split AIRFLOW	Refrigerant Charge On-Site Survey (n)	FINAL Pass / Fail Rate
PASS	55	39	16	72	42%
FAIL	77	59	18	56	58%
DK	18	52	18	22	-

3.4. PGE2000 Multifamily Program

Program Overview

PG&E's Mass Markets (PGE2000) program targets single-family and multifamily residential retrofit and commercial customers, who often lack information, time, and resources to engage in energy efficiency projects. The Mass Markets program uses PG&E staff, third-party specialists, and local government partnerships to deliver a portfolio of energy efficiency, demand response, and distributed generation services. It includes statewide elements as well as elements specially targeted to mass market customers in PG&E's service area.

The Multifamily rebate program component within PGE2000 provides incentives to multifamily property owners and managers for the following types of measures:

- Appliances (clothes washers, dishwashers, coin-op clothes washers)
- Infiltration and building-shell related measures (ceiling and wall insulation, windows, Cool Roofs)
- HVAC measures (central natural gas furnaces, packaged terminal air conditioners, room air conditioners, evaporative coolers, etc.)
- Water heating measures (electric and gas storage water heaters, gas water heater/boiler controllers, central gas boilers, steam traps)
- Lighting measures (T8/T5 linear fluorescent fixtures, exterior and interior CFLs fixtures, LED exit signs, photocells and occupancy sensors, CFL ceiling fan fixtures, and R30/R40 reflector lamps)
- Swimming pool measures (filtration pumps, pool heaters, filters and pool lights)

The CPUC and the Cadmus team determined the high-impact measure groups for the PGE2000 program's verification effort are residential interior lighting and residential exterior lighting. Table 13 presents program achievements reported through Q4 2007 for these high-impact measures.

Table 13. PGE2000 Multifamily Program Claims (2006-2007)⁸

Measure Description	Quantity
Res Interior Lighting	426,405
Res Exterior Lighting	91,198

⁸ per Q4 2007 E3 Calculator.

Installation Verification Sampling and Methodology

Verification Priorities

The two high-impact measure groups for the multifamily component of PGE2000 are the residential interior lighting and residential exterior lighting measures. Data collection to verify these high-impact measures was based upon sample sizes selected to yield verification results with 10-percent precision at the 90-percent confidence level at the program level, and a research and data collection effort designed to minimize any potential biases.

Participant Surveys

As part of both the verification and evaluation efforts, telephone surveys were conducted with a randomly selected sample of program participants who installed one or more of the high-impact measures. For the two lighting measures, there were enough participants who installed the measures to be able to randomly select a sample that achieved the 90/10 confidence/precision goal. An attempt was made to contact all of these sites by phone in the hope of finding as many as possible to agree to an on-site visit.

During the phone surveys, participants were asked questions regarding: whether the measure is still installed and operating; the program's role in their decision to purchase the measure; their reasons for purchasing the measure; the efficiency of the original measure; and whether they have participated in other related PG&E programs.⁹ Table 14, on the following page, provides the number of unique sites where the high-impact measures were installed and on-site verification visits were conducted. The on-site verification sample was selected from the sample of completed phone surveys.

Site Visits

To validate installation of the energy efficiency measure listed in the program tracking data, the Cadmus team conducted site visits for a selected sample of participants from the high-impact measure (HIM) groups. The on-site sample sizes for each of the high-impact measures were calculated using a sampling algorithm that combined the number of unique sites where the measure was installed and the desire for results with 10 percent precision at the 90 percent confidence level. The site visit participants were recruited during phone survey efforts. Table 14 lists the sample sizes for the site-visits.¹⁰

⁹ The first of these was used in the verification effort and the others are part of the evaluation inquiry.

¹⁰ A site is defined as a multifamily complex. In most cases, multiple installations of high-efficiency measures were verified at each site.

Table 14. PGE2000 Multifamily Program Sample Sizes¹¹

High Impact Measure Group	Participating Multifamily Sites (Through 4Q 2007)*	Site Visits**
Res Interior Lighting	2,546	71
Res Exterior Lighting	1,536	56

* A multifamily site is a multifamily complex.

** The count of on-sites completed is the number of multifamily complexes visited to verify measure installations. For many sites, more than one measure was verified.

Verification of Program Installations

The multifamily verification effort used on-site visits to determine if: (a) the quantity of rebated measures listed in the program tracking databases matched the quantity of rebated measures recorded on the program application forms; and (b) the rebated measures were installed and operational.

For each site visited, the team compared data contained on PG&E application forms with the type and quantity of measures listed in the program tracking databases. In some cases, the total quantity of measures listed on the program application forms did not match the quantity of measures in these databases. In these cases, an application-based quantity adjustment factor was calculated.¹²

In addition, the team verified the quantity of measures found to be installed and operational in both apartments and common areas at each site visited. For most sites, the team visited a sub-sample of apartments with installed measures to verify the measure installations. The verification percentage observed in the sub-sampled areas was weighted by the number of measures reported rebated from the application data to determine a site-level verified quantity.

Table 15, on the following page, presents the adjustments made to the quantity of measures rebated, based on the application/tracking data comparison and the site-level verification results. The combined On-site Verification Quantity Adjustment is the product of both the application-based quantity adjustment and the quantity.

As shown, it was determined that 90.7 percent of residential interior lighting measures matched the application forms and were found to be installed and operable during the site visits. For residential exterior lighting measures, it was found that only 74.4 percent matched the quantity recorded on the application forms and were installed and operable during the site visits.

¹¹ The site visit participants were recruited during phone survey efforts, thus are a subset of the telephone survey participants.

¹² Note that the application review was required to identify individual units to visit as part of the site visits.

Table 15. PGE2000 Multifamily Program Verification Findings

HIM Group	Application Quantity/Tracking Quantity	Application-Based Quantity Adjustment	Quantity Installed & Operable/Application Quantity	% Units Installed and Operable	Total Survey Adjustment*
Res Interior Lighting	16,607 / 17,564	94.5%	2,904 / 3,028	95.9%	90.7%
Res Exterior Lighting	5,387 / 5,927	90.9%	1,650 / 2,015	81.9%	74.4%

*Total survey adjustment is the product of the application-based quantity adjustment and the percent of units installed and operating.

3.5. PGE2000 Single Family Program

Program Overview

PG&E's Mass Markets (PGE2000) program targets single-family and multifamily residential retrofit and commercial customers, who often lack information, time, and resources to engage in energy efficiency projects. The Mass Markets program uses PG&E staff, third-party specialists, and local government partnerships to deliver a portfolio of energy efficiency, demand response, and distributed generation services. It includes statewide elements as well as elements specially targeted to mass market customers in PG&E's service area.

The component within PGE2000 that is targeted primarily to single family homeowners provides incentives to for the following types of measures:

- Appliances (e.g., clothes washers, dishwashers and room air conditioners)
- Water heaters
- Pool pumps and motors
- Central natural gas furnaces
- Ceiling and wall insulation

The CPUC and project team evaluators determined that the PGE2000 Program's dishwashers, room air conditioners, clothes washers, water heaters, pool pumps, natural gas furnaces, wall insulation, and ceiling (attic) insulation measures are high-impact program measure groups for the PG&E verification effort. Program achievements reported through Q4 2007 for rebated measures are presented in Table 16, on the following page.

Table 16. PGE2000 Single Family Rebate Measures and Program Claims (2006-2007)¹³

Measure Description	Quantity
Dishwasher	33,086
Room air conditioner*	4,426
Clothes washer**	94,201
Storage Water Heater**	5,513
Pool pumps**	1,765
Central natural gas furnace**	22,391
Wall insulation***	3,122,905
Ceiling (attic) insulation****	11,295,395

Installation Verification Sampling and Methodology

Verification Priorities

We based our data collection to verify the various measures on sample sizes that would yield verification results within 10-percent precision at the 90-percent confidence level at the overall program level. The research and data collection was designed to minimize any potential bias.

Participant Surveys

To verify program-incented measure installation, the phone survey was based upon a randomly selected sample of program participants and stratified by program measure type.

Participants who purchased energy-efficient dishwashers, room air conditioners, clothes washers, water heaters, pool pumps, natural gas furnaces, wall or ceiling (attic) insulation, were asked questions regarding whether the unit was still installed and operational, the program's role in influencing their decision to purchase the energy-efficient unit, average usage, water heating fuel type (gas, electric, or solar), whether the unit was a replacement, and participation in other related PG&E programs. Site visits to a select sample of telephone survey participants who had purchased these specific measures were used to validate the results. The site visit participants were recruited during the phone survey effort.

Table 17 lists the total numbers of participants, telephone surveys, and site visits.

¹³ per Q4 2007 E3 Calculator.

Table 17. PGE2000 Single Family Sample Sizes

Measure Description	Participants (through 4Q 2007)	Telephone Surveys	Site Visits	Total Sq. Ft. Rebated at Site Visit Locations
Dishwashers	33019	197	33	NA
Room Air Conditioner	4150	91	10	NA
Clothes Washers	94173	215	37	NA
Storage Water Heater	5468	82	10	NA
Single-Speed Pool Pump and Motor	617	25	3	NA
Multi-Speed Pool Pump (and Motor)	935	36	4	NA
Variable Speed Pool Pump (and Motor)	211	17	3	NA
Central Natural Gas Furnace	22116	173	35	NA
Wall Insulation (sq. ft.)	3288	46	14	14,052 sq. ft.
Ceiling (Attic) Insulation (sq. ft.)	8017	139	27	43,945 sq. ft.

Installation Results

Dishwashers

Table 18 presents results from the telephone and on-site surveys for the dishwasher measures. Telephone survey results for the dishwasher rebate program revealed that one rebated dishwasher from the sample of 197 rebated dishwashers was used when it was purchased. While all Program measures were installed and operating, the ineligibility of the one used dishwasher reveals a realization rate of 99.49 percent. On-site inspection of the dishwasher measures confirmed that all of those units participants had described as installed and operating properly were, in fact, doing so (100-percent confirmation of the telephone survey responses).

Table 18. PGE2000 Verification Findings for Dishwasher Measures

	Phone Survey (N = 197)	On-site Survey* (N = 33)	Total Survey Adjustment**
% of units currently installed	99.49% (196)	100.00% (33)	99.49%
% of units not installed	0.00% (0)	0.00% (0)	NA
Used when purchased	0.51% (1)	NA	NA

* The site visit participants were recruited during phone survey efforts and, thus, are a subset of the telephone survey participants

** Realization rate is the product of the % of units currently installed from the phone survey and the on-site survey

Room Air Conditioners

Table 19, on the following page, presents results from telephone and on-site surveys for the room A/C measure. Telephone survey results for this measure revealed that 5.49 percent of room A/C units were not installed and working within PG&E's service territory. A small number (2.2 percent) were in storage because they are only used during certain times of the year. These room A/C units were considered to be installed and operational because of their ease of removal/installation, combined with seasonal necessity for air conditioning in some climate zones.

Table 19. PGE2000 Verification Findings for Room A/C Measures

	Phone Survey (N = 91)	On-Site Survey* (N = 9)	Total Survey Adjustment**
% of units currently installed	94.51% (86)	100.00% (9)	94.51%
% of units not installed	5.49% (5)	0.00% (0)	NA

* The site visit participants were recruited during phone survey efforts and, thus, are a subset of the telephone survey participants

** Realization rate is the product of the % of units currently installed from the phone survey and the on-site survey

Clothes Washers

Table 20 presents results from the telephone and on-site surveys for the clothes washer measures. Telephone survey results for the clothes washer rebate program revealed that two rebated clothes washers from the sample of 215 rebated clothes washers were used when it was purchased. While all Program measures were installed and operating, the ineligibility of the two used clothes washers reveals a realization rate of 99.07 percent. On-site inspection of the clothes washer measures confirmed that all of the units participants described as installed and operating properly were in fact doing so (100-percent confirmation of the telephone survey responses).

Table 20. PGE2000 Verification Findings for Clothes Washer Measures

	Phone Survey (N = 215)	On-site Survey* (N = 37)	Total Survey Adjustment**
% of units currently installed	99.07% (213)	100.00% (37)	99.07%
% of units not installed	0.93% (2)	0.00% (0)	NA

* The site visit participants were recruited during phone survey efforts and, thus, are a subset of the telephone survey participants

** Realization rate is the product of the % of units currently installed from the phone survey and the on-site survey

Water Heaters Table 21 presents results from the telephone and on-site surveys for the water heater measures. Telephone survey results for the water heater measures revealed that all Program measures were installed and operating. However, one water heater was reported to be in used condition when purchased, and another was reported as tankless/on demand, revealing a realization rate for eligible water heaters of 97.56 percent. On-site inspection of the water heaters confirmed that all of the units participants described as eligible, installed, and operating properly were, in fact, doing so (100-percent confirmation of the telephone survey responses).

Table 21. PGE2000 Verification Findings for Water Heater Measures

	Phone Survey (N = 82)	On-site Survey* (N = 10)	Total Survey Adjustment**
% of units currently installed	97.56% (80)	100.00% (10)	97.56%
% of units not installed	0.00% (0)	0.00% (0)	NA
% of units ineligible	2.44% (2)	0.00% (0)	NA

* The site visit participants were recruited during phone survey efforts and, thus, are a subset of the telephone survey participants

** Realization rate is the product of the % of units currently installed from the phone survey and the on-site survey

Pool Pumps

Table 22 presents results from the telephone and on-site surveys for the pool pump measures. Telephone survey results for the pool pump rebate program revealed that one rebated pool pump from the sample of 77 rebated pool pumps was installed in an above ground pool. While all

Program measures were installed and operating, the ineligibility of the one pool pump reveals a realization rate of 98.70 percent. On-site inspection of the pool pump measures confirmed that all of the units participants described as installed and operating properly were, in fact, doing so (100-percent confirmation of the telephone survey responses).

Table 22. PGE2000 Verification Findings for Pool Pump Measures

	Phone Survey (N = 77)	On-site Survey* (N = 9)	Total Survey Adjustment**
% of units currently installed	98.70% (76)	100.00% (9)	98.70%
% of units not installed	0.00% (0)	0.00% (0)	NA
Installed in above ground pool	1.30% (1)	NA	NA

* The site visit participants were recruited during phone survey efforts and, thus, are a subset of the telephone survey participants

** Realization rate is the product of the % of units currently installed from the phone survey and the on-site survey

Central Natural Gas Furnaces

Table 23 presents results from the telephone and on-site surveys for the furnace measures. Telephone survey results for the furnace rebate program revealed that a small percentage of furnaces (0.61 percent) had been permanently removed. On-site inspection of the furnace measures confirmed that all of the units participants described as installed and operating properly were, in fact, doing so. However, one rebated furnace (3.23 percent) was found to be a heat pump, which is ineligible for a rebate. A total survey adjustment of 96.18 percent is realized for the furnace measures.

Table 23. PGE2000 Verification Findings for Furnace Measures

	Phone Survey (N = 163)	On-site Survey* (N = 31)	Total Survey Adjustment**
% of units currently installed	99.39% (162)	96.77% (30)	96.18%
% of units not installed	0.61% (1)	3.23% (1)	NA

* The site visit participants were recruited during phone survey efforts and, thus, are a subset of the telephone survey participants

** Realization rate is the product of the % of units currently installed from the phone survey and the on-site survey.

Wall Insulation Table 24, on the following page, presents results from the telephone and on-site surveys for the wall insulation measure. A significant portion of the insulation installations (32.61 percent of participants from the telephone survey, and 1,786 sq. ft. from the on-site verification) did not adhere to the program eligibility requirements. These requirements state the following:

- Only uninsulated walls may receive rebated insulation
- All materials must be new
- Residence must have space heating or cooling that uses either natural gas or electricity provided by PG&E
- Insulation must be installed in walls that separate conditioned living areas from unconditioned areas, and that garages or non-living areas do not count

- Insulation must achieve a minimum of R-13

If these criteria were not met for an amount of insulation found at a home or during a telephone survey, that square footage (or residence) was counted as ineligible. The two most significant reasons why insulation was found ineligible was that walls had been previously insulated and that walls were insulated between conditioned and conditioned living spaces or between non-conditioned and non-conditioned spaces. During the phone survey, it was found that some installations included both eligible and ineligible installations because some insulation was installed in eligible locations, while other insulation was installed properly. For the sake of this verification, these respondents were considered to have eligible insulation.

Due to the amount of ineligible insulation found during phone surveys and on-site surveys, a realization rate of 58.82 percent is applied for the total survey adjustment.

Table 24. PGE2000 Verification Findings for Wall Insulation

	Phone Survey (N = 46)	On-Site Survey* (N = 14052 sq ft)	Total Survey Adjustment**
% of units currently installed	67.39% (31)	87.29% (12,266)	58.82%
% of units not installed or ineligible	32.61% (15)	12.71% (1,786)	NA

* The site visit participants were recruited during phone survey efforts and thus are a subset of the telephone survey participants

** Realization rate is the product of the % of units currently installed from the phone survey and the on-site survey.

Ceiling (Attic) Insulation

Table 25, on the following page, presents results from the telephone and on-site surveys for the ceiling (attic) insulation measure. A significant portion of the insulation installations (11.76 percent of participants from the telephone survey, and 20,828 sq. ft. from the on-site verification) did not adhere to the program eligibility requirements. These requirements state the following:

- Insulation is eligible only if the pre-retrofit insulation level was R-11 or less
- All materials must be new
- Residence must have space heating or cooling that uses either natural gas or electricity provided by PG&E2000 Mass Markets Single Family Measures On-Site Verification
- Insulation must be installed between conditioned living areas and unconditioned areas, and that garages or non-living areas do not count
- Insulation must achieve a minimum of R-30 if there is 24 inches of space between the ceiling joists and the highest peak of the roof rafters. If this space is less than 24 inches, a minimum insulation level of R-19 must be installed.

If these criteria were not met for an amount of insulation found at a home or during a telephone survey, that square footage (or residence) was counted as ineligible. The two most significant reasons why insulation was found ineligible were that:

- pre-retrofit insulation levels were too high (greater than R-11) and

- ceilings (or parts of ceilings) were insulated between non-conditioned and non-conditioned spaces such as in garages or in entry-way overhangs.

During the phone survey, it was found that some installations included both eligible and ineligible installations, because some insulation was installed in eligible locations, while other insulation was installed properly. For the sake of this verification, these respondents were considered to have eligible insulation.

Due to the amount of ineligible insulation found during phone surveys and on-site surveys, a realization rate of 46.41 percent is applied for the total survey adjustment.

Table 25. PGE2000 Verification Findings for Ceiling (Attic) Insulation

	Phone Survey (N = 136)	On-site Survey* (N = 43945)	Total Survey Adjustment**
% of units currently installed	88.24% (120)	52.60% (23,117)	46.41%
% of units not installed or ineligible	11.76% (16)	47.40% (20,828)	NA

* The site visit participants were recruited during phone survey efforts and, thus, are a subset of the telephone survey participants

** Realization rate is the product of the % of units currently installed from the phone survey and the on-site survey.

3.6. SCE2500 Appliance Recycling

Program Overview

The Appliance Recycling program (ARP) seeks to produce cost-effective, long-term, coincident peak demand reduction and annual energy savings in residential and nonresidential market sectors by removing operable, inefficient, primary and secondary refrigerators, freezers, and room air conditioners from the power grid in an environmentally safe manner. To stimulate participation, ARP offers incentives for eligible refrigerators (\$25), freezers (\$50), and room air conditioners (\$25). In addition, ARP collaborates with other utility programs such as the Residential Energy Efficiency Incentive program and Multifamily Energy Efficiency Rebate program. These programs help encourage ARP participants to replace retired units with ENERGY STAR[®]-qualified refrigerators, freezers, and room air conditioners.

The 2006–2008 program included two significant changes to previous program iterations: the addition of room air conditioners; and expanding eligibility to include small commercial businesses. The ARP added room air conditioners at the suggestion of the Program Advisory Group (PAG), based on market saturation and potential for additional cost-effective, long-term, coincident peak demand reduction, and long-term, annual energy savings. The addition of room air conditioners complements the existing ARP portfolio and supplements the ENERGY STAR[®]-qualified room air conditioner rebate offered through other utility programs. Implementation of room air conditioners follows the best practice model established through the Keep Cool Bounty program of New York State Energy Research and Development Authority (NYSERDA). Also, as a number of office complexes and industrial buildings have standard, residential-size refrigerators and freezers, the PAG recommended expanding the 2006-2008

ARP. In response, the program now offers incentives to select nonresidential customers, including office complexes, industrial customers, schools, and municipalities.

The CPUC and project team evaluators determined that two of SCE2500 program's three measures, refrigerator and freezer recycling, are high-impact program measure groups for the SCE verification effort. Program achievements reported through Q4 2007 for these two high-impact measures are presented in Table 26.

Table 26. SCE2500 Program Claims (2006-2007)¹⁴

Measure Description	Quantity
Recycle Refrigerator	109,890
Recycle Freezer	17,217

Installation Verification Sampling and Methodology

Verification Priorities

As noted above, two of the three ARP customer-rebated measures were considered high-impact combinations: refrigerator and freezer recycling. Consequently, data collection for the verification of these measures was based upon sample sizes selected to yield verification results with 10-percent precision at the 90-percent confidence level at the program level and a research and data collection design to minimize any potential biases.

Participant Surveys

To verify program-incented measure removal, the phone survey was based upon a randomly selected sample of program participants and stratified by program measure.

Participants who had an older refrigerator and freezer recycled were asked questions regarding whether the unit was removed from their home, the program's role in the decision to remove the unit, the usage patterns of the removed appliance, and participation in other related SCE programs.¹⁵ No site visits were conducted as part of this verification effort. See Table 27, on the following page, for the detailed sample size and stratification of the telephone surveys.

¹⁴ per Q4 2007 E3 Calculator.

¹⁵ The first of these is the inquiry used for the verification analyses. The others will be used for the impact evaluation.

Table 27. SCE2500 Sample Sizes¹⁶

Measure	Participants (Through 4Q 2007)	Telephone Surveys	Site Visits
Recycle Refrigerator	106,232	232	NA
Recycle Freezer	17,010	89	NA

Installation Results

Table 28 and Table 29, on the following page, present results from telephone surveys for recycled refrigerators and freezers. Telephone survey results for both recycled refrigerators and freezers revealed that all program measures were removed for a verification rate of 100 percent.

Table 28. SCE2500 Verification Findings for Recycled Refrigerators

	Phone Survey (N=232)	On-site Survey* (N=0)	Total Survey Adjustment**
% of units confirmed as removed	100.0% (232)	NA	100.0%
% of units not confirmed as removed	0.0% (0)	NA	NA

*No site visits conducted, recognizing that a site visits provides no greater accuracy as it is not possible to confirm on-site that a unit was previously there and then removed.

**Realization rate is the product of the % of units currently installed/operable/operable from the phone survey and the on-site surveys

Table 29. SCE2500 Verification Findings for Recycled Freezers

	Phone Survey (N=89)	On-site Survey* (N=0)	Total Survey Adjustment**
% of units confirmed as removed	100.0% (89)	NA	100.0%
% of units not confirmed as removed	0.0% (0)	NA	NA

*No site visits conducted, recognizing that a site visits provides no greater accuracy as it is not possible to confirm on-site that a unit was previously there and then removed.

**Realization rate is the product of the % of units currently installed/operable/operable from the phone survey and the on-site surveys

¹⁶ No on-site surveys were conducted as part of this verification effort.

3.7. SCE2501 Residential Incentive Program

Program Overview

The Residential Energy Efficiency Incentive Program (REEIP) seeks to provide the residential and specific non-residential markets with incentives to purchase high-efficiency products. REEIP offers upstream lighting incentives and rebates on lighting measures including: Compact Fluorescent Lighting (CFL), high-efficiency fixtures, lighting controls, address signs, and cold cathode lighting. In addition, the program contains a light fixture exchange component. Non-lighting incentives offered by the program include: pool pumps and motors, ENERGY STAR® refrigerators and room air conditioners, whole house fans, electric storage water heaters, attic and wall insulation, cool roofs, and evaporative coolers. Although upstream lighting represents a significant share of the Program's savings, this chapter only addresses high-impact measures from the downstream components of the program; the verification findings from the upstream lighting component are covered in the next chapter.

In addition to traditional mail-in rebates, REEIP utilizes a point-of-sale (POS) rebate delivery method for some measures. The program establishes relationships with retailers who agree to stock qualifying products and provide an instant rebate for the customer at check-out. The utility reimburses the retailer for the rebate, eliminating the need for customers to fill out a rebate application. This method simplifies participation for consumers, increases stocking levels at participating retailers, and is expected to expand participation levels. Those not purchasing qualifying products from a participating retailer continue to have the option of a mail-in or online rebate application.

In addition to achieving specific participation goals for each measure and annual energy savings goals, REEIP plans to:

- Link incentives for the purchase of new equipment to recycling opportunities. The Program seeks to accelerate the increase in market share by facilitating consumer purchase of new units and the removal of old, inefficient units.
- Expand POS measures and activities.
- Educate customers about the benefits of energy efficiency to create demand for higher-efficiency products.
- Encourage retail stores and home improvement centers to increase stocking and sales of energy-efficient lighting, appliances, and equipment.

The CPUC and project team evaluators determined that the SCE2501 Program's whole-house fans, evaporative coolers, room air-conditioners, and lighting fixtures are high-impact program measure groups for the SCE verification effort.¹⁷

Installation Verification Sampling and Methodology

Verification Priorities

Four of the REEIP end-use customer-rebated measures were considered high-impact combinations: whole-house fans, evaporative coolers, room air-conditioners, and lighting fixtures. Consequently, data collection for the verification of these measures was based upon sample sizes selected to yield verification results with 10-percent precision at the 90-percent confidence level at the program level and a research and data collection design to minimize any potential biases.

Participant Surveys

In an effort to verify program-incented measures were installed and are operational, as well as to determine the appropriate net-to-gross ratio for each measure for the evaluation effort, the evaluation team surveyed a randomly selected sample of program participants, stratified by Program measure. Participants that applied for rebates via the three options – POS, mail in rebate, and Internet – were included in the sample.

Participants were asked questions regarding the program's role in their decision to purchase the unit, whether the unit was a replacement, the efficiency of original (if applicable), whether it is currently installed and operational within the service territory, and participation in other related SCE programs (e.g., ARP and MFEER). See Table 30 for the detailed sample size and stratification of the telephone surveys.

Table 30. SCE2501 Sample Sizes¹⁸

Measure	Participants (Through 4Q 2007)	Telephone Surveys	Site Visits
Whole House Fans	11,049	157	NA
Evaporative Coolers	911	172	NA
Room Air Conditioner	104,223	426	NA
Lighting Exchange	105,169	136	NA

¹⁷ As noted above, the verification effort for the upstream lighting component of the SCE2501 program is covered in the next chapter.

¹⁸ No on-site surveys were conducted as part of this verification effort for the whole house fans, evaporative coolers, and lighting exchange because it was determined that the savings for these measures were small and that telephone verification would be sufficient. For room air conditioners on-site verification will be conducted as part of the metering effort in the evaluation study.

Installation Results

The following tables provide results from telephone surveys for whole-house fan, evaporative cooler, room AC, and lighting exchange measures. Results for the room AC telephone surveys showed that 15 units (3 percent) were no longer installed or operating. When asked why the room air conditioning unit was not currently installed, participant answers included:¹⁹

- Two participants installed their room AC outside of SCE service territory,
- Three participants sold or gave their room AC away and do not know if units were installed in SCE service territory,
- Two participants removed their room AC and would not disclose reason,
- Five participants have room AC in storage and refused to disclose when or if they would install them, and
- Three participants removed the AC units due to installation of central air.

For lighting fixtures, 11 lighting exchange units (7.4 percent) were also no longer installed or operating. When asked why the fixture was not currently installed participants offered a variety of answers including:

- Six participants removed lighting units because they failed or were not working properly, and these were not replaced with efficient units.
- Five participants did not install lighting units and refused to disclose when or if they would install them.

Table 31. SCE2501 Verification Findings for House Fans

	Phone Survey (N=157)	On-Site Survey* (N=0)	Total Survey Adjustment
% of units currently installed/operable	100.0% (157)	NA	100.0%
% of units not installed/operable	0.0% (0)	NA	NA

* No on-site surveys were conducted as part of this verification effort.

Table 32. SCE2501 Verification Findings for Evaporative Cooler

	Phone Survey (N=172)	On-Site Survey* (N=0)	Total Survey Adjustment
% of units currently installed/operable	100.0% (172)	NA	100.0%
% of units not installed/operable	0.0% (0)	NA	NA

* No on-site surveys were conducted as part of this verification effort.

¹⁹ Note that for room AC verification, units that were not currently installed because they were in storage until needed (*i.e.*, for hotter weather) were not counted against the savings verifications values.

Table 33. SCE2501 Verification Findings for Room AC

	Phone Survey (N=426)	On-Site Survey* (N=0)	Total Survey Adjustment
% of units currently installed/operable	96.5% (409)	NA	96.5%
% of units not installed/operable	3.5% (15)	NA	NA

* No on-site surveys were conducted as part of this verification effort.

Table 34. SCE2501 Verification Findings for Lighting Exchange

	Phone Survey (N=149)	On-Site Survey* (N=0)	Total Survey Adjustment
% of units currently installed/operable	92.6% (138)	NA	92.6%
% of units not installed/operable	7.4% (11)	NA	NA

* No on-site surveys were conducted as part of this verification effort.

3.8. SCE2501 Upstream Lighting Program

Program Overview

The Upstream Lighting Program component of SCE2501 provides incentives to manufacturers and retailers for qualified energy-efficient lighting products. SCE claims that the program's underlying market-based approach provides the greatest flexibility for introducing new methods and penetrating new markets, thereby helping the utility expand customer participation. SCE's multi-pronged strategy incorporates methods such as:

- Incentives tiered by product type and lumen,
- Manufacturer wholesale buy-down and retailer point-of-sale (POS) discount, and
- Varied promotional efforts, including bill inserts, direct mail, in-store promotional materials, promotional sales events, and product competitions.

Program implementation starts with promotional announcements to manufacturers and retailers. Then these participants reserve fund allocations for planned sales promotions. The retailers display the discounted products (marked with stickers), along with promotional messaging and signs, to indicate that SCE is providing the discount. According to SCE, in most cases the lighting manufacturer reduces the wholesale price to the retailer who passes it on to the customer in the form of a POS discount. SCE indicates that sometimes retailers may apply POS discounts directly to products purchased at the normal wholesale price. These retailers discount the prices at their own initial expense and SCE later reimburses them.

SCE offers specialized promotions, customized to different locales and market channels. These promotions can include both mass customer promotions as well as targeted campaigns involving manufacturers and retailers of specific kinds of products. Examples include: specialty bulb promotions, targeted bill inserts, direct mailings, up-selling promotions, internet campaigns, efforts to open new long-term sales channels, and lamp exchange events.

During the first two years of the program, SCE provided incentives for the types of lighting products listed in Table 35. As shown, the vast majority of lighting products rebated through the Upstream Lighting Program during 2006-2007 were traditional, bent-tube or twister-style CFLs of relatively low wattage (e.g., 9-23 watts). Four percent of rebated lighting products were specialty CFLs, (e.g., reflector-style, globe shape, or dimmable). Less than 3 percent of rebated lighting products were energy-efficient exterior or interior CFL fixtures. SCE also rebated two types of energy-efficient night lights (LED and electro-luminescent), as well as LED plug-in desk lamps.

During 2006-2007, SCE provided approximately \$46 million in rebates to participating manufacturers and retailers. As mentioned above, rebate levels vary by product type and promotional strategy. The average rebate paid for lighting products distributed through the Upstream Lighting Program during 2006-2007 is just under \$2.00.

Table 35. Lighting Products and Rebates Paid through SCE2501 Upstream Lighting Program (2006-2007)

Type of Lighting Product	Units Rebated	Percent of Units Rebated	Average Rebate Amount		Total Rebates	Percent of Total Rebates
			Min	Max		
Electro-Luminescent Night Light	283,188	1.2%	\$0.30	\$1.00	\$161,968	0.4%
Exterior fixture	189,084	0.8%	\$10.00	\$10.00	\$1,890,840	4.1%
Interior fixture	374,989	1.6%	\$10.00	\$10.00	\$3,749,890	8.1%
LED Plug-in Desk Lamp	221,200	0.9%	\$4.67	\$4.67	\$1,033,004	2.2%
LED Plug-in Night Lights	853,392	3.6%	\$0.30	\$1.25	\$756,390	1.6%
Traditional bent-tube/twister-style CFLs	20,734,840	87.8%	\$0.35	\$2.00	\$36,740,015	79.8%
Specialty CFL (e.g., reflector, globe, dimmable)	953,467	4.0%	\$1.00	\$3.50	\$1,728,184	3.8%
Total	23,610,160				\$46,060,290	

The CPUC and the Residential Retrofit Evaluation Team determined that all of the measures rebated through the SCE2501 Upstream Lighting Program are high-impact program measure groups for the SCE verification effort. Program achievements reported through Q4 2007 are presented in Table 36, on the following page.

Table 36. SCE2501 Upstream Lighting Program Claims (2006-2007)²⁰

HIM Group	Quantity
Upstream C&I Interior screw-in lighting	2,163,684
Upstream Res Interior screw-in lighting	19,524,623
Upstream Res Exterior lighting fixture	189,084
Upstream Res Interior lighting fixture	1,732,769
	23,610,160

Verification Methodology

All of the measures groups included in the SCE2501 Upstream Lighting Program were considered high-impact. Table 37 describes the data collection effort and sample sizes undertaken for the verification.

Table 37. SCE2501 Upstream Lighting Program Verification Sample Sizes

Verification Objective	Data Collection Activity	Sample Size
Verify res/nonres split	Review best available data	NA
Verify residential screw-in measure installation rate	CFL User Telephone Survey	781 / 309 (SCE)
Verify residential fixture measure installation rate	Review best available information	NA
Verify C&I screw-in measure installation rate	Review best available information	NA
Verify C&I fixture measure installation rate	Review best available information	NA

Verification of Residential/Nonresidential Split

According to SCE work papers, SCE assumes that 10 percent of the screw-in CFLs rebated through the Upstream Lighting Program will be installed in nonresidential applications. SCE assigned nonresidential per unit savings values to 10 percent of the rebated units. SCE assumed that 100 percent of the exterior and interior CFL fixtures rebated through the Upstream Lighting Program would be installed in residential applications and assigned residential per unit savings values to these measures.

The residential/nonresidential split assumption will be fully evaluated as part of the overall evaluation effort for the Upstream Lighting Program. The team is conducting in-store intercepts to identify purchasers of rebated CFLs who intend to install the products in nonresidential applications. In addition, we are conducting surveys with manufacturers and participating retailers to obtain their best estimates of the volume of rebated CFLs that eventually is installed

²⁰ per Q4 2007 E3 Calculator.

in nonresidential applications. The team also is surveying both residential and nonresidential end-use customers to estimate the volume of CFLs purchased through retail locations that eventually are installed in nonresidential applications. The Residential Retrofit Evaluation Team is conducting surveys with property managers to determine the volume of CFLs purchased through retail locations that are eventually installed in leased properties. Finally, we also are conducting surveys with lighting and electrical contractors to assess the volume of CFLs purchased through retail locations that are eventually installed in nonresidential applications. This evaluation research is being coordinated between the Residential Retrofit and Small Commercial Evaluation Contract Groups.

Given that this evaluation research is ongoing, this first Verification Report relied on a review of the best available information to verify the residential/nonresidential split assumption for the Upstream Lighting Program. The results of this review are discussed later in this chapter.

Verification of Measure Installation Rate

SCE assumes a 90-percent in-service rate for residential and nonresidential screw-in CFLs rebated through the Upstream Lighting Program. SCE assumes a 100-percent in-service rate for residential CFL fixtures (exterior and interior).

As part of the overall evaluation of the Upstream Lighting Program, we will develop an estimate of the distribution of time-to-installation for CFLs rebated during 2006-2008 and installed in residential applications. We will also use data from CFL user telephone surveys to develop relationships among bulb acquisition, installation and storage rates, and to develop a profile of household CFL usage patterns. The survey will be conducted in waves (every 3 months for 5 quarters, starting in June 2008 and ending in June 2009) and will produce a total sample of 1,500 CFL users. We will rely on CFL survey data being collected by the Small Commercial Contract Group to assess installation rates for screw-in CFLs installed in nonresidential applications.

The evaluation will also address installation rates for interior and exterior lighting fixtures installed in residential fixtures.

Since only the first wave of the CFL user telephone survey has been completed, we relied on a review of the best available information to verify SCE's assumed 90-percent residential in-service rate for the Upstream Lighting Program. We also relied on the best available information to verify SCE's assumed 90-percent in-service rate for nonresidential screw-in CFLs and the assumed 100-percent in-service rates for lighting fixtures installed in interior and exterior residential applications.

We discuss the results of this review of best available information and the recommended installation rate below.

Installation Results

Table 38 summarizes the results from verification activities completed for the Upstream Lighting Program, followed by a discussion of the assessment conducted for each verification objective.

Table 38. SCE2501 Upstream Lighting Program Verification Findings

Verification Objective	Data Collection Activity	Verification Result
Verify res/nonres split	Review best available data	Inconclusive
Verify residential screw-in CFL installation rate	CFL User Telephone Survey	67% (SCE assumed 90%)
Verify residential lighting fixture installation rate	Review best available information	100% (SCE assumed 100%)
Verify C&I screw-in CFL installation rate	Review best available information	67% (SCE assumed 90%)

Verification of Residential/Nonresidential Split

SCE work papers discussed the justification for assuming that 10 percent of the screw-in CFLs rebated through the Upstream Lighting Program would be installed in nonresidential applications. SCE cited a study it completed in 1994 in which compiled information provided through survey cards. Based on the responses received, SCE determined that between 12 percent and 19 percent of CFLs purchased through the program were installed in nonresidential applications. SCE used this result to set a conservative 10 percent target for the 2006-2008 Upstream Lighting Program.

Other sources of information related to the residential/nonresidential split include:

- End-use customer surveys completed in support of the 2004-2005 Express Efficiency and Single Family Rebate (SFR) Program Evaluations suggest that less than 10 percent of customers purchase CFLs from retail locations and go on to install them in nonresidential applications.
 - The commercial customer surveys completed for the evaluation of the 2004-2005 Express Efficiency Program indicated that less than 3 percent of commercial customers purchase CFLs from retailers for installation in their place of business.
 - The residential customer surveys completed for the evaluation of the 2004-2005 SFR Program indicated that 7% of residential customers purchase CFLs from retailers that eventually get installed in nonresidential applications.
- This result is consistent with the results of the first wave of the CFL User telephone survey conducted as part of the evaluation of the 2006-2008 Upstream Lighting Program. In this most recent survey (completed in June 2008), residential customers indicated that 7 percent of the CFLs purchased at retail locations were eventually installed in nonresidential applications.
- Finally, PG&E and SCE 2006-2008 Upstream Lighting Program process evaluation findings which, based on retail store manager self-reported estimates, suggest that between 14 to 22 percent of CFLs purchased from participating retailers are installed in nonresidential applications.

At this time, we do not have enough reliable information to verify the accuracy of the utilities assumptions regarding the residential/nonresidential split. As discussed above, the

residential/nonresidential split assumption will be further examined as part of the evaluation of the 2006-2008 Upstream Lighting Program.

Verification of Measure Installation Rate

Residential Screw-In CFL Installation Rate

Our primary source of evidence for estimating residential in-service rates for screw-in CFLs purchased through the 2006-2008 Upstream Lighting Program is the first wave of the CFL User telephone survey conducted in June 2008.^{21[1]} The results of this survey indicate that 67 percent of CFLs purchased between January 2006 and June 2008 are installed and 24 percent are in storage. The rest either burned out, broke, were given away, or installed but later removed, as shown in Table 16. This table also shows that 51 percent of CFLs purchased between April and June 2008 are installed and 47 percent are in storage.

^{21[1]} The CFL user telephone survey is expected to provide data that will be used to estimate the distribution of time-to-installation for CFLs. Data from these surveys will also be used to develop econometric-based estimates of relationships among bulb acquisition, installation and storage rates, and develop a profile of household CFL usage patterns. Conducted in waves (*i.e.*, every 3 months for 5 quarters, starting in June 2008 and ending in June 2009), this survey will produce a total sample of 1,500 CFL users.

Table 39 Summary of Evidence for Upstream Lighting Program Installation Rates

	April - June 2008		Between January 2006 - June 2008	
Number of respondents who purchased CFLs	118		344	
Average number of CFLs purchased (among purchasers)	10		13	
Average number of CFLs purchased (among all households)	2		6	
Total quantity of CFLs purchased	1,189		4,430	
- installed at primary residence or another residence located within IOU service territory	612	51%	2,958	67%
- stored at primary residence or another residence located within IOU service territory	563	47%	1,070	24%
- burned out	7	1%	217	5%
- given away	0	0%	79	2%
- installed but later removed (uncertain if being stored or not)	0	0%	59	1%
- broke	7	1%	35	1%
- returned	0	0%	12	0%
- misplaced	0	0%	0	0%
- installed in another residential location outside of IOU service territory	2	0%	0	0%
In-Service Rate	51%		67%	
- includes installs at primary residence and other locations within IOU service territory				
- excludes dk and refused responses				

When all waves of CFL user telephone survey have been completed, the Residential Retrofit Evaluation team will analyze the residential in-service rate applicable to the 2006-2008 program and adjust the results accordingly. This final evaluation residential screw-in installation rate result will be based upon 1,500 CFL User surveys completed across 5 survey waves and an econometric-based CFL acquisition, installation, storage model.

Residential Lighting Fixture Installation Rate

SCE assumes 100 percent of the residential lighting fixtures rebated through the Upstream Lighting Program are installed and operational. This is consistent with most programs offering rebates for residential lighting fixtures. However, we did not find any studies or other research that could verify these assumptions. At this time, we accept SCE's 100-percent installation rate for residential lighting fixtures. We will assess this assumption further as part of the ongoing evaluation effort.

C&I Screw-In CFL Measure Installation Rate

As mentioned above, PG&E assumes that the in-service rate for screw-in CFLs rebated through the Upstream Lighting Program is the same for both residential and nonresidential applications. At this time, we assume the same in-service rate for residential CFLs rebated through the Upstream Lighting Program also applies to nonresidential CFLs. This assumption will be verified as part of the ongoing evaluation through surveys with nonresidential customers, property management and maintenance companies, contractors and other lighting vendors.

3.9. SCE2502 Multifamily Energy Efficiency Rebates

Program Overview

The Multifamily Energy Efficiency Rebate Program (SCE2502) is designed to motivate multifamily property owners/managers towards the installation of energy efficient products into both individual apartment dwelling units as well as the common areas associated with the multifamily properties. The Program offered rebates for high efficiency residential interior screw-in CFL lamps and reflectors, residential interior and exterior fluorescent lighting fixtures, such as T-8 lamps, exit signs, and delamping, lighting controls such as occupancy sensors and photocells, attic and wall insulation, refrigerators, room air conditioners, electric water heaters, and high performance dual pane low-E windows.

The multifamily sector of the residential market has tremendous savings potential, however, significant barriers to participation exist including the split incentive issue and out-of-pocket expenses required of multifamily property owners. The split incentive issue exists in this market sector since tenants pay the utility bills and property owners receive no energy cost savings in return for the installation of energy efficient equipment in tenant units. To eliminate the barrier regarding measure installation in individual apartment dwellings, rebate levels have been structured to help alleviate the out-of-pocket capital costs faced by property owners, with the tenants of these units the beneficiaries of lower energy costs. Additionally, prescribed rebates motivate property owners/managers to install energy efficient equipment in common areas, since they are responsible for this cost.

The SCE2502 Program objectives for the 2006-2008 program cycle include:

- Realizing a noticeable increase in property owner/manager self-initiated rebate requests,
- Increasing overall participation by multifamily property owners and managers and especially gain participation of at least three mega-property management companies per year, and
- An ongoing increase in program awareness amongst non-participating multifamily property owners/managers through advertisements in trade journals that circulate in SCE's service territory, direct mailings to potential program participants, and word-of-mouth by vendors and distributors who serve the multifamily property sector.

The CPUC and project team evaluators determined that the high-impact measure groups for the SCE2502 Program's verification effort are Residential Interior Lighting and Residential Exterior Lighting.²² Program achievements reported through Q4 2007 for the high-impact measures are presented in Table 40.

²² The residential interior lighting is residential interior fixtures. The residential exterior lighting is residential exterior fixtures and screw-in high efficiency lighting. The interior screw-in lighting is not included in the residential interior lighting because it is in a separate MECT measure group.

Table 40. SCE2502 Program Claims (2006-2007)²³

Measure Description	Quantity
Res Exterior Lighting	232,274
Res Interior Lighting	751,071

Installation Verification Sampling and Methodology

Verification Priorities

The two high-impact measure groups for the multifamily component of SCE2502 included Residential Interior Lighting and Residential Exterior Lighting. Data collection for the verification of these high-impact measures was based upon sample sizes selected to yield verification results with 10-percent precision at the 90-percent confidence level at the program level and a research and data collection design to minimize any potential biases.

Participant Surveys

Participant phone surveys were used to recruit sites for on-site verification. The recruitments were conducted with a randomly selected sample of program participants who installed one or more of the high-impact measures. For both of the lighting measures the population of sites who installed these measures was large enough (~4,000 unique sites for each of the measures) to be able to randomly select a sample that would allow us to achieve our goal 90/10 confidence/precision goal.

Table 41, on the following page, provides the number of unique sites where the high-impact measures were installed and the on-site verification visits that took place (selected from the sample of completed phone surveys).

Site Visits

To validate the installation of the energy efficiency measure listed in the program tracking data site visits were conducted on a selected sample of participants from the HIM groups. The on-site sample sizes for each of the high-impact measures were calculated using a sampling algorithm that combined the number of unique sites where the measure was installed and the desire for results with 10-percent precision at the 90-percent confidence level. The site visit participants were recruited during phone survey efforts. Table 41 lists sample size of site visits.

²³ per

Table 41. SCE 2502 Sample Sizes²⁴

Utility	Measure	Participating Multifamily Sites*	On-Sites Completed**
SCE	Res Exterior Lighting	3,855	62
SCE	Res Interior Lighting	6,424	70

* A Multifamily site is a multifamily complex.

** The number of on-sites completed is the number of multifamily complexes visited. A multifamily site can be counted for both HIMs. For most sites, multiple apartments within the site would have been verified.

Verification of Measure Installation Rate

The multifamily verification effort used on-site visits to determine if the rebated measures were installed and operational. The team verified the installation of measures reported in the utility's tracking database. For sites verified, the installed quantities were compared to the tracking quantity recorded as installed within the verified apartments or common area. For most sites, a sub-sample of apartments with installed measures was visited to verify the measure installations. The verification percentage observed in the sub-sampled areas was weighted by the number of measures reported as incented from the tracking data to determine a site level verified quantity.

The site verification visits included 62 multifamily sites with exterior lighting. The exterior lighting HIM includes both exterior fixtures and screw-in CFLs. At the 62 multifamily sites 4,151 exterior lighting measures were listed on the tracking data. The on-site visits found that 9.1 percent of the tracking quantities could not be verified as installed and operational, or 378 measures were not currently installed and operational. Few explanations were given to the on-site surveyors for missing exterior lighting; in the cases where reasons were provided, the property managers and tenants expressed that patio lighting was too dim and therefore brighter, non-rebated lamps were installed. In other cases the on-site surveyors found rebated fixtures in place but with non-rebated lamps installed.

The on-site verification also included 70 multifamily sites with interior lighting. The interior lighting HIM was restricted to interior fixtures. At the 70 sites, 14,599 interior lighting measures were listed on the tracking data. The visits found that 4.64 percent of the measures could not be verified as currently installed and operational. At most of the sites with less than 100-percent verification, rebated lamps were replaced due to lamp failure. In a few cases, tenants and property managers expressed dissatisfaction with fluorescent lighting due to noise and flickering and made substitutions for these lamps and fixtures as well. The total survey adjustment for interior lighting fixtures was 95.63 percent. Table 42 presents details.

²⁴ The site visit participants were recruited during phone survey efforts and thus are a subset of the telephone survey participants.

Table 42. SCE2502 On-Site Verification Findings

	On-Site Survey	Total Survey Adjustment**
Residential Exterior Lighting (n=62)		
% of units currently installed/operable	90.90%	90.90%
% of units not installed/operable	9.10%	NA
Residential Interior Lighting (n=70)		
% of units currently installed/operable	95.36%	95.36%
% of units not installed/operable	4.64%	NA

3.10. SCE2502 Comprehensive Manufactured / Mobile Home Program

Program Overview

SCE2502 consists of two residential components: a multifamily component and manufactured/mobile home component. The multifamily component is the larger of the two and seeks to produce cost-effective demand reduction and energy savings in the multifamily residential segment.²⁵

The SCE2502 Comprehensive Manufactured-Mobile Home program (CMMHP) seeks to produce cost-effective, long-term, coincident peak demand reduction and annual energy savings in the residential market sector. The program installs or performs as many of the following measures and activities as possible in existing manufactured homes: duct test and seal, AC diagnostic and tune-up, Compact Fluorescent Lamps (CFLs), faucet aerators, low-flow showerheads, CFL hardwire fixtures, and efficiency upgrades to common area lighting (CFL bulbs and fixtures). The AC measure consists of a check on refrigerant charge and airflow, which is why other programs often refer to this measure as RCA.

To stimulate participation, CMMHP measures are installed free of charge. The program provides general information on energy efficiency to manufactured home residents and specific information about measures installed in their homes. Each customer receives an energy efficiency tips brochure that also teaches about other energy efficiency programs, and provides phone numbers and contact information for those interested.

²⁵ The findings from the multifamily component were presented in the previous chapter.

The program implementer, American Synergy Companies (ASC), delivered this program for SCE in 2004-2005. In 2006-2008, the program—again implemented by ASC—delivers these comprehensive retrofits in all four IOU service territories. SCE and SCG continue to sponsor and operate the program jointly in their shared service territory.

The CPUC and project team evaluators determined that the SCE2502 program's duct test and seal and AC diagnostic measures are high-impact program measure groups for the SCE verification effort. Program achievements reported through Q4 2007 for these two high-impact measures are presented in Table 43.

Table 43. SCE2502 Program Claims (2006-2007)²⁶

Measure Description	Quantity
Duct Test and Seal	6,209
AC Diagnostic	8,887

Installation Verification Sampling and Methodology

Verification Priorities

Two of the CMMHP-installed measures are when taken together identified as a high-impact measure group: duct test and seal, and AC diagnostic tune-up. Consequently, data collection to verify these measures was based upon sample sizes selected to yield verification results for the measure group with 10-percent precision at the 90-percent confidence level at the program level, and with a research and data collection process designed to minimize any potential biases.

Participant Surveys

To verify program-incented measure installation, the phone survey was based on a randomly selected sample of program participants and stratified by the two HVAC program measures.

Participants sign up to have their homes treated by the program implementer with every measure expected to produce savings. In the phone survey, participants were asked: to confirm the HVAC measure(s) were installed; whether other program measures were still installed and operating; and what role the program played in their decision to have the HVAC measure installed. Table 44, on the following page, provides more detail on telephone survey sample size and stratification.

²⁶ per Q4 2007 E3 Calculator.

Site Visits

To validate the telephone survey results, the Residential Retrofit Evaluation Team conducted site visits on a selected sample of participants in the duct test and seal or AC diagnostic measures. The site visit participants were recruited during phone survey efforts. Table 44 provides site visit sample sizes.

Table 44. SCE2502 CMMHP Sample Sizes

Measure	Participants ¹ (Through 4Q 2007)	Telephone Surveys	Site Visits ²
Duct Test and Seal	6,209	90	35
AC Diagnostic	8,887	150	54

¹ Total participants receiving each measure are shown. Since many participants received both of these HVAC measures, the number of unique program participants is less than the sum of these two counts.

² In 2008, 73 site visits were conducted, but 16 of these had both HVAC measures.

Installation Results

The following tables present results from telephone and on-site surveys for the HVAC measures — duct test and seal and AC diagnostic and tune-up. Survey respondents reported that the duct work had been completed at every home but one, for a verification rate of 98.9 percent. Similarly, for the AC measure, all but one of the respondents were able to verify that they had received the measure, for a verification rate of 99.3 percent.

On-site inspections also found that duct and AC work had been completed in the participant homes. However, the technicians' ability to verify the two high-impact measures was limited due to the nature of those measures. In practice, verification was based on the limited physical evidence that a measure had been implemented, which was supplemented by the participant's recollection of the work performed. The physical evidence—consisting of stickers on AC units and some evidence that ducts had been sealed—only served to demonstrate something may have been done. The measurable physical characteristics such as duct leakage and refrigerant charge were not verifiable by the visual inspections.

Table 45. SCE2502 CMMHP Verification Findings for Duct Test and Seal

	Phone Survey (N=90)	On-site Survey* (N=35)	Total Survey Adjustment**
% of units currently installed/operable	98.9% (89)	100.0% (35)	98.9%
Measure could not be verified	1.1% (1)	NA	NA

* The site visit participants were recruited during phone survey efforts and thus are a subset of the telephone survey participants.

**Realization rate is the product of the % of units currently installed/operable/operable from the phone survey and the on-site surveys

Table 46. SCE 2502 CMMHP Verification Findings for AC Diagnostic and Tune-Up

	Phone Survey (N=150)	On-Site Survey* (N=54)	Total Survey Adjustment**
% of units currently installed/operable	99.3% (149)	100.0% (54)	99.3%
Measure could not be verified	0.7% (1)	NA	NA

* The site visit participants were recruited during phone survey efforts, thus are a subset of the telephone survey participants.

**Realization rate is the product of the % of units currently installed/operable/operable from the phone survey and the on-site surveys.

3.11. SCG3510 Multifamily Energy Efficiency Retrofit Program

Program Overview

SCG's Multifamily Energy Efficiency Retrofit (MFEER) program (SCG3510) targets property owners and managers of multifamily residential dwellings, homeowners associations, and mobile home park associations in its service territory. The program encourages property owners and managers to install qualifying energy efficiency products in common areas as well as in tenant units. The program offers rebates for attic and wall insulation, gas water heaters and water heater controllers, gas boilers, clothes washers, dishwashers, and gas furnaces.

In the past, the multifamily market segment has been considered hard-to-reach; prior to 2002, the multifamily market segment did not actively participate in energy efficiency programs. This segment continues to pose significant market barriers compared to other residential segments. Specifically, there is a "split incentive" divide between property owners and tenants because multifamily residents typically pay their own energy bills and thus there is no incentive for property owners to improve their rental properties. Since the property owner, manager, or homeowners associations are responsible only for facility improvements, they have little or no incentive to install energy efficiency measures in individual units.

The MFEER program combines information, education, targeted marketing and customer incentives to encourage property owners/managers to install energy efficient measures. The program attempts to reach a greater diversity of customers, including small investor groups holding multiple apartment sites, property managers of large tenant dwellings, and a greater number of community and homeowner associations, through targeted campaigns and the possible use of upstream vendors.

The SCG3510 program objectives are:

- Bring a portfolio of measures and rebates to customers via market vendors, manufacturers, and installers to increase customer participation in energy efficiency initiatives.
- Achieve energy savings that exceed the target allocated to the residential segment.
- Simplify the process by which customers can participate.
- Reduce direct implementation costs over time.
- Heighten energy efficiency awareness and knowledge of both the multifamily property owner/managers and their tenants.

The CPUC and project team evaluators determined the SCG3510 program's Residential Water Heater Controller measure group is the only high-impact program measure group for the SCG verification effort. Program achievements reported through Q4 2007 for the high-impact measures included in this group are presented in Table 47, on the following page.

Table 47. SCG3510 Program Claims (2006-2007)²⁷

Measure Description	Quantity
Res Water Heater Controllers	789

Installation Verification Sampling and Methodology

Verification Priorities

The only high-impact measure for the multifamily component of SCG3510 is water heater/boiler controllers. Data collection for the verification of this high-impact measure was based on sample sizes selected to yield verification results with 10-percent precision at the 90-percent confidence level at the program level, and a research and data collection effort designed to minimize any potential biases.

Participant Surveys

As part of both the verification and evaluation efforts, telephone surveys were conducted with a randomly selected sample of program participants who installed one or more of the high-impact measures. For the two water heater control measures, there were enough participants to select a random sample that achieved the 90/10 confidence/precision goal. An attempt was made to contact all of these sites by phone so as to find as many as possible to agree to an on-site visit.

During the phone surveys, participants were asked questions regarding: whether the measure is still installed and operating; the program's role in their decision to purchase the measure; their reasons for purchasing the measure; the efficiency of the original measure; and whether they have participated in other related SCG programs.²⁸ Table 48 provides the number of unique sites where the high-impact measures were installed and on-site verification visits were conducted. The on-site verification sample was selected from the sample of completed phone surveys.

Site Visits

To validate the installation of the energy efficiency measure listed in the program tracking data, site visits were conducted on a selected sample of participants from the HIM group. The on-site sample size for the water heater/boiler controller measure was calculated to provide results with 10-percent precision at the 90-percent confidence level. Site visit participants were recruited during phone survey efforts. Table 48, on the following page, shows the number of site visits conducted.

²⁷ per Q4 2007 E3 Calculator.

²⁸ The first inquiry was asked to support this verification effort. The latter inquiries were made to support the evaluation effort.

Table 48. SCG3510 Sample Sizes

Measure	Participating Multifamily Sites (Through 4Q 2007)**	Site Visits**
Res Water Heater Controls	256	43

* A multifamily site is a multifamily complex.

** The count of on-sites completed is the number of multifamily complexes visited to verify boiler controls. For many sites, more than one controller was verified.

Installation Results

The multifamily verification effort used on-site visits to determine if the rebated water heater/boiler controller measures were installed and operational. The Residential Retrofit Evaluation Team verified the installation of measures reported in the utility's tracking databases and compared the quantity installed at each site with the quantity recorded in the database. For most sites, the Residential Retrofit Evaluation Team verified all claimed boiler control measures. In cases where only a sub-sample could be verified, the verification percentage observed in the sub-sample was weighted by the number of measures reported as incented from the tracking data to determine a site-level verified quantity.²⁹

As shown in Table 49, results from the site visits showed that 14 out of 146 water heating controllers (9.6 percent) were no longer installed or operating. Reasons cited during the on-site survey include controllers disconnected by maintenance contractors due to overheating of the water, missing controllers, and improper operation due possibly to faulty wiring.³⁰ An on-site survey adjustment rate of 90.4 percent was achieved for SCG's water heating control measures.

Table 49. SCE3510 Verification Findings for Residential Water Heating Controllers

	On-Site Survey (n=146)*	Total Survey Adjustment
% of units currently installed/operable	90.4% (132)	90.4%
% of units not installed/operable	9.6% (14)	NA

* A total of 142 boiler controllers were listed in the tracking data for the 41 sites visited during the verification process.

²⁹ In general, all boiler controllers at a site visited by the field team would have been verified. If the on-site contact limited the access of the field team, however, a sub-sample of the installed controllers may have been verified.

³⁰ The site with missing water heating controls subsequently installed solar water heating measures. While the management remembers the installation of the boiler controls, they could not provide additional information about their current disposition.

3.12. SCG3517 Single-Family Rebate (Residential Incentive Program)

Program Overview

SCG's 2006-2008 Single-Family Energy Efficiency Retrofit (SFEER) program seeks to help residential customers reduce their natural gas usage with rebates for replacing less efficient gas-fired equipment with new energy-efficient equipment. The program also offers weatherization services. The program uses an array of tactics to influence key market actors. These tactics include incentive rebates, education, and outreach. The program targets customers, retailers, manufacturers, distributors, and contractors.

SCG has chosen to implement SFEER itself, using a single program approach, rather than separate local programs, to ensure consistency with other statewide offerings and to leverage overall portfolio dollars. By offering substantial rebates and making them easy for customers to claim, the SCG SFEER hopes to reach single-family homeowners who have not previously installed energy-efficient measures.

The program's three-year budget of \$19.5M anticipates a projected annual energy savings goal of 4,689,000 therms. The specific measures the SFEER program encourages its customers to install are: high-efficiency appliances, including gas storage water heaters, ENERGY STAR® dishwashers, ENERGY STAR® and other clothes washers, central gas furnaces, and additional attic and wall insulation.

For the SCG verification effort, the CPUC and the Cadmus team determined that the SCG3517 program has two high-impact measure groups—Residential Appliances and Residential Opaque Shell. The Residential Appliances measure group includes qualifying dishwashers and clothes washers. The Residential Opaque Shell measure group includes attic insulation and wall insulation. Program achievements reported through Q4 2007 for these four high-impact measures are presented in Table 50.

Table 50. SCG 3517 Program Claims (2006-2007)³¹

Measure Description	Quantity
Attic Insulation*	8,501,326
Wall Insulation*	3,509,042
Dishwasher	19,913
Clothes Washer	47,030

³¹ per Q4 2007 E3 Calculator.

To be eligible for these rebates, applicants must be the owner of a single-family home, condominium, or attached residential units (maximum of four). Qualifying measures include:

- ENERGY STAR®-qualified clothes washers and dishwashers
- Attic Insulation: Any existing insulation must be R-11 or less. The final insulation level must be R-30 or R-19 if there is less than 24 inches of attic space.
- Wall Insulation: Existing walls must be un-insulated and the installed insulation must achieve a minimum of R-13.

Installation Verification Sampling and Methodology

Verification Priorities

Four of the SFEER end-use, customer-rebated measures were considered high-impact: attic insulation, wall insulation, energy-efficient dishwashers, and energy-efficient clothes washers. Consequently, data collection for the verification of these measures was based upon sample sizes selected to yield verification results with 10-percent precision at the 90-percent confidence level at the program level and a research and data collection design to minimize any potential biases.

Participant Surveys

To verify program-incented measure installation, the phone survey was based upon a randomly selected sample of program participants and stratified by program measure. Participants who purchased any program measure were asked questions regarding whether the measure was still installed and operating, the program's role in their decision to purchase the unit, whether the unit was a replacement, age and efficiency of unit it replaced, age of the home, and participation in other related SCG programs. Table 51 shows telephone survey sample sizes and stratification.

Site Visits

To validate the results of the telephone survey, site visits were also conducted on a selected sample of participants. Most site visit participants were recruited during the phone surveys. Due to difficulties in scheduling site visits with this first set of recruits, some additional participants were selected randomly from the tracking database and contacted regarding site visits. With these supplemental recruits, the evaluation team was able to reach the site visit targets required to ensure 90-percent confidence and 10-percent precision for each measure group. Table 51 shows details on the site visit sample.

Table 51. SCG 3517 Sample Sizes

Measure Group	Measure	Participants (Through Q4 2007)	Telephone Surveys	Site Visits by Measure	Site Visits by Measure Group
Residential Opaque Shell	Attic Insulation	5,813	196	37	73
	Wall Insulation	3,090	153	36	
Residential Appliances	Dishwasher	19,913	110	43	71
	Clothes Washer	47,030	114	28	

Installation Results

The tables on this and the following page represent results from telephone and on-site surveys for attic insulation, wall insulation, dishwashers, and clothes washers. Telephone survey results for these measures revealed a small number of cases where the measures were not installed.

- For wall insulation, all of the participants surveyed reported that the measure was installed at the expected location.
- For attic insulation, dishwashers, and clothes washers, however, there were one or two participants in each group—or ~1 percent—who reported the measure was not installed at the expected location. Three of these participants reported that the measure had been installed at another location, possibly outside of the SCG service territory. For the one clothes washer that was not currently installed, the participant reported the unit had been recalled.

On-site inspection of the four high-impact measures confirmed all of the measures that participants said were installed were operating properly (100-percent confirmation of the telephone survey responses).

Table 52. SCG 3517 Verification Findings for Attic Insulation

	Phone Survey (N=196)	On-Site Survey* (N=37)	Total Survey Adjustment**
% of units currently installed/operable/operable	99.5% (195)	100.0% (37)	99.5%
% of units not installed/operable/operable	0.5% (1)	0.0% (0)	N/A
% Installed at another location	0.5% (1)	N/A	N/A

* Most site visit participants were recruited during phone survey efforts and thus are a subset of the telephone survey participants.

**Realization rate is the product of the % of units currently installed/operable/operable from the phone survey and the on-site surveys

Table 53. SCG 3517 Verification Findings for Wall Insulation

	Phone Survey (N=153)	On-Site Survey* (N=36)	Total Survey Adjustment**
% of units currently installed/operable/operable	100.0% (153)	100.0% (36)	100.0%
% of units not installed/operable/operable	0.0% (0)	0.0% (0)	N/A

* Most site visit participants were recruited during phone survey efforts and thus are a subset of the telephone survey participants.

**Realization rate is the product of the % of units currently installed/operable/operable from the phone survey and the on-site surveys

Table 54. SCG 3517 Verification Findings for Dishwashers

	Phone Survey (N=110)	On-site Survey* (N=35)	Total Survey Adjustment**
% of units currently installed/operable/operable	99.1% (109)	100.0% (43)	99.1%
% of units not installed/operable/operable	0.9% (1)	0.0% (0)	N/A
Installed at another location	0.9% (1)	N/A	N/A

* Most site visit participants were recruited during phone survey efforts and thus are a subset of the telephone survey participants.

	Phone Survey (N=110)	On-site Survey* (N=35)	Total Survey Adjustment**
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**Realization rate is the product of the % of units currently installed/operable from the phone survey and the on-site surveys

Table 55. SCG 3517 Verification Findings for Clothes Washers

	Phone Survey (N=114)	On-site Survey* (N=28)	Total Survey Adjustment**
% of units currently installed/operable	98.2% (112)	100.0% (28)	98.2%
% of units not installed/operable/operable	1.8% (2)	0.0% (0)	N/A
Installed at another location	0.9% (1)	N/A	N/A
Unit was recalled	0.9% (1)	N/A	N/A

* Most site visit participants were recruited during phone survey efforts and thus are a subset of the telephone survey participants.

**Realization rate is the product of the % of units currently installed/operable from the phone survey and the on-site surveys

3.13. SDGE3016 Upstream Lighting Program

Program Overview

SDG&E's Upstream Lighting Program provides rebates to consumers via manufacturer-to-retailer discounts or buy-downs to motivate consumers to purchase and install qualifying energy-efficient lighting products. The program targets single-family homeowners, renters and multifamily tenants, and offers incentives for the following measures in 2006-2008:

- Standard Screw-in CFLs
- Specialty CFLs and Fixtures
- Interior and Exterior Fixtures
- Table & Floor Lamps, Torchieres
- Night Lights (including LED)
- Interior LEDs (non-night lights)
- Cold Cathodes

SDG&E sent out an open RFP to manufacturers and retailers to solicit their participation in the program. SDG&E evaluated all proposals on the variety of product, areas of distribution, and type of retailer targeted.

SDG&E directs its marketing to manufacturers and retailers. The program also targets non-residential customers (such as small business owners/customers) to the extent they shop for lighting products at participating retailers. Additional marketing includes:

- Bill Inserts
- In-store promotional materials

- Direct mailings
- Promotional sales events
- Product competitions

During the first two years of the program, SDG&E provided incentives for the types of lighting products listed in Table 56. As shown, the vast majority of lighting products receiving rebates through the Upstream Lighting Program during 2006-2007 were traditional, bent-tube, or twister-style CFLs of relatively low wattage (*e.g.*, 9-23 watts). Eleven percent of rebated lighting products were specialty CFLs (such as reflector-style, globe shape, or dimmable). About 2 percent of rebated lighting products were energy-efficient exterior or interior CFL fixtures. SDG&E also provided rebates for a considerable quantity of various LED lighting products (such as bulbs, holiday lights, open/closed signs, or task lamps).

During 2006-2007, SDG&E provided over \$9 million in rebates to participating manufacturers and retailers. Rebate levels varied by product type and promotional strategy. The average rebate paid for lighting products distributed through the SDG&E Upstream Lighting Program during 2006-2007 was \$1.63.

Table 56. Lighting Products and Rebates Paid through SDGE3016 Upstream Lighting Program (2006-2007)

Type of Lighting Product	Units Rebated	Percent of Units Rebated	Average Rebate Amount		Total Rebates	Percent of Total Rebates
			Min	Max		
Exterior Fixture	31,652	1%	\$10.00	\$10.00	\$316,520	3%
Interior Fixture	46,175	1%	\$10.00	\$10.00	\$461,750	5%
LED Products (<i>e.g.</i> , bulbs, holiday lights, open/closed signs, task lamps)	903,091	16%	\$0.06	\$12.00	\$531,259	6%
Specialty CFL (<i>e.g.</i> , reflector, globe, dimmable)	610,960	11%	\$1.00	\$2.00	\$808,547	9%
Traditional tube/twister-style CFLs	4,170,283	72%	\$1.00	\$2.00	\$7,281,508	77%
	5,762,161				\$9,399,583	

The CPUC and the Residential Retrofit Evaluation Team determined all the measures rebated through the SDGE3016 Upstream Lighting Program were high-impact for the SDG&E verification effort. Table 57 presents program achievements through Q4 2007.

**Table 57. SDGE3016 Upstream Lighting Program Claims
(2006-2007)³²**

HIM Group	Quantity
Upstream Res Exterior lighting	588,932
Upstream Res Interior lighting	52,370
Upstream Res Interior screw lighting	5,120,859
	5,762,161

Verification Methodology

All of the measure groups in the SDGE3016 Upstream Lighting Program are considered high-impact. Table 58 describes the data collection effort and sample sizes undertaken for the verification.

Table 58. SDGE3016 Upstream Lighting Program Verification Sample Sizes

Verification Objective	Data Collection Activity	Sample Size
Verify res/nonres split	Review best available data	NA
Verify residential screw-in lighting installation rate	CFL User Telephone Survey	781 / 146 (SDG&E)
Verify residential lighting fixture installation rate	Review best available information	NA

Verification of Residential/Nonresidential Split

SDG&E assumed 100 percent of the lighting products rebated through the Upstream Lighting Program would be installed in residential applications. This assumption will be fully evaluated as part of the overall evaluation effort for the Upstream Lighting Program.

The team is conducting in-store intercepts to identify purchasers of rebated CFLs who intend to install the products in nonresidential applications. In addition, we are conducting surveys with manufacturers and participating retailers to obtain their best estimates of the volume of rebated CFLs that eventually is installed in nonresidential applications. The team also is surveying both residential and nonresidential end-use customers to estimate the volume of CFLs purchased through retail locations that eventually are installed in nonresidential applications. The Residential Retrofit Evaluation Team is conducting surveys with property managers to determine the volume of CFLs purchased through retail locations that are eventually installed in leased properties. Finally, we also are conducting surveys with lighting and electrical contractors to assess the volume of CFLs purchased through retail locations that are eventually installed in

³² per Q4 2007 E3 Calculator.

nonresidential applications. This evaluation research is being coordinated between the Residential Retrofit and Small Commercial Evaluation Contract Groups.

Given that this evaluation research is ongoing, this First Verification Report relied on a review of the best available information to verify the residential/nonresidential split assumption for the Upstream Lighting Program. The results of this review are discussed later in this chapter.

Verification of Measure Installation Rate

SDG&E assumes a 90-percent in-service rate for the screw-in CFLs rebated through the Upstream Lighting Program. SDG&E assumes a 100-percent in-service rate for residential CFL fixtures (exterior and interior).

As part of the overall evaluation of the Upstream Lighting Program, we will develop an estimate of the distribution of time-to-installation for CFLs rebated during 2006-2008 and installed in residential applications. We will also use data from CFL user telephone surveys to develop relationships among bulb acquisition, installation and storage rates, and to develop a profile of household CFL usage patterns. The survey will be conducted in waves (every 3 months for 5 quarters, starting in June 2008 and ending in June 2009) and will produce a total sample of 1,500 CFL users. We will rely on CFL survey data being collected by the Small Commercial Contract Group to assess installation rates for screw-in CFLs installed in nonresidential applications.

The evaluation will also address installation rates for interior and exterior lighting fixtures installed in residential fixtures.

Since only the first wave of the CFL user telephone survey has been completed, we relied on a review of the best available information to verify SDG&E's assumed 90-percent residential in-service rate for the Upstream Lighting Program. We also relied on the best available information to verify SDG&E's assumed 100-percent in-service rates for lighting fixtures installed in interior and exterior residential applications.

We discuss the results of this review of best available information and the recommended installation rate below.

Installation Results

Table 59 summarizes results from verification activities completed for the Upstream Lighting Program, followed by a discussion of the assessment conducted for each verification objective.

Table 59. SDGE3016 Upstream Lighting Program Verification Findings

Verification Objective	Data Collection Activity	Verification Result
Verify res/nonres split	Review best available data	100% verified
Verify residential screw-in lighting installation rate	CFL User Telephone Survey	67% (SDG&E assumed 90%)
Verify residential lighting fixture installation rate	Review best available information	100% (SDG&E assumed 100%)

Verification of Residential/Nonresidential Split

As mentioned above, SDG&E assumed 100 percent of the lighting products rebated through the Upstream Lighting Program would be installed in residential applications.

As justification for its assumptions regarding the residential/nonresidential split, SCE cited a study it completed in 1994 in which compiled information provided through survey cards. Based on the responses received, SCE determined that between 12 percent and 19 percent of CFLs purchased through the program were installed in nonresidential applications. SCE used this result to set a conservative 10 percent target for the 2006-2008 Upstream Lighting Program.

Other sources of information related to the residential/nonresidential split include:

- End-use customer surveys completed in support of the 2004-2005 Express Efficiency and Single Family Rebate (SFR) Program Evaluations suggest that less than 10 percent of customers purchase CFLs from retail locations and go on to install them in nonresidential applications.
 - The commercial customer surveys completed for the evaluation of the 2004-2005 Express Efficiency Program indicated that less than 3 percent of commercial customers purchase CFLs from retailers for installation in their place of business.
 - The residential customer surveys completed for the evaluation of the 2004-2005 SFR Program indicated that 7 percent of residential customers purchase CFLs from retailers that eventually get installed in nonresidential applications.
- This result is consistent with results of the first wave of the CFL User telephone survey conducted as part of the evaluation of the 2006-2008 Upstream Lighting Program. In this most recent survey (completed in June 2008), residential customers indicated that 7 percent of the CFLs purchased at retail locations were eventually installed in nonresidential applications.
- Finally, PG&E and SCE 2006-2008 Upstream Lighting Program process evaluation findings, which, based on retail store manager self-reported estimates, suggest that between 14 percent and 22 percent of CFLs purchased from participating retailers are installed in nonresidential applications.

At this time, we do not have enough reliable information to verify the accuracy of the utilities assumptions regarding the residential/nonresidential split. As discussed above, the residential/nonresidential split assumption will be further examined as part of the evaluation of the 2006-2008 Upstream Lighting Program.

Verification of Measure Installation Rate

Residential Screw-In CFL Installation Rate

Our primary source of evidence for estimating residential in-service rates for screw-in CFLs purchased through the 2006-2008 Upstream Lighting Program is the first wave of the CFL User telephone survey conducted in June 2008.^{33[1]} The results of this survey indicate that 67 percent of CFLs purchased between January 2006 and June 2008 are installed and 24 percent are in storage. The rest either burned out, broke, were given away, or installed but later removed, as shown in Table 16. This table also shows that 51 percent of CFLs purchased between April and June 2008 are installed and 47 percent are in storage.

Table 60. Summary of Evidence for Upstream Lighting Program Installation Rates

	April - June 2008		Between January 2006 - June 2008	
Number of respondents who purchased CFLs	118		344	
Average number of CFLs purchased (among purchasers)	10		13	
Average number of CFLs purchased (among all households)	2		6	
Total quantity of CFLs purchased	1,189		4,430	
- installed at primary residence or another residence located within IOU service territory	612	51%	2,958	67%
- stored at primary residence or another residence located within IOU service territory	563	47%	1,070	24%
- burned out	7	1%	217	5%
- given away	0	0%	79	2%
- installed but later removed (uncertain if being stored or not)	0	0%	59	1%
- broke	7	1%	35	1%
- returned	0	0%	12	0%
- misplaced	0	0%	0	0%
- installed in another residential location outside of IOU service territory	2	0%	0	0%
In-Service Rate	51%		67%	
- includes installs at primary residence and other locations within IOU service territory				
- excludes dk and refused responses				

When all waves of CFL user telephone survey have been completed, the Residential Retrofit Evaluation team will analyze the residential in-service rate applicable to the 2006-2008 program

^{33[1]} The CFL user telephone survey is expected to provide data that will be used to estimate the distribution of time-to-installation for CFLs. Data from these surveys will also be used to develop econometric-based estimates of relationships among bulb acquisition, installation and storage rates, and develop a profile of household CFL usage patterns. Conducted in waves (*i.e.*, every 3 months for 5 quarters, starting in June 2008 and ending in June 2009), this survey will produce a total sample of 1,500 CFL users.

and adjust the results accordingly. This final evaluation residential screw-in installation rate result will be based upon 1,500 CFL User surveys completed across 5 survey waves and an econometric-based CFL acquisition, installation, storage model.

Residential Lighting Fixture Installation Rate

SDG&E assumes 100 percent of the residential lighting fixtures rebated through the Upstream Lighting Program are installed and operational. This is consistent with most programs offering rebates for residential lighting fixtures. However, we did not find any studies or other research that could verify these assumptions. At this time, we accept SDG&E's 100-percent installation rate for residential lighting fixtures. We will assess this assumption further as part of the ongoing evaluation effort.

3.14. SDGE3017 Multifamily Rebate Program

Program Overview

The SDGE3017 Multifamily Rebate Program (MFRP) is designed to motivate multifamily property owners/managers to install energy efficient products in both individual apartments and common areas. The program offers rebates for high efficiency residential interior screw-in CFL lamps, reflectors, residential interior and exterior fluorescent lighting fixtures (such as T-8 lamps and exit signs), lighting controls (such as photocells), attic insulation, room air conditioners, gas water heaters, water heater controllers, low flow faucet aerators, showerheads, and dishwashers.

The multifamily sector of the residential market has tremendous savings potential, but significant barriers to program participation. One such barrier is the issue of split incentives since the tenant pays utility bills and thus property owners receive no energy cost savings for installing energy efficient measures in their rental properties. Other barriers to participation include the out-of-pocket expenses required of multifamily property owners and the lack of education provided to property owners concerning the non-energy benefits associated with the installation of energy efficient measures. These benefits could include the property owners' ability to promote the apartments as energy efficient units with lower than expected utility costs. To address the issue of split incentives, rebate levels have been structured to help alleviate the out-of-pocket capital costs faced by property owners, which also lowers energy costs for tenants. Additionally, prescribed rebates motivate property owners/managers to install energy efficient equipment in common areas, since they are responsible for this cost.

The SDGE3017 Program objectives for the 2006-2008 program cycle include:

- The use of the Residential Downstream Deemed Rebates approach to contractors/property managers and owners.
- Promoting the program through marketing strategies such as direct mail, presentations at community housing workshops, local multi-family association meetings and online.
- Improving the installation of gas measures by focusing on educating and expanding alliances with property managers/owners, gas product distributors, plumbers, and other gas product contractors.
- Enhance current contacts with property managers via the San Diego Apartment Association and continue to use the current 45-day reservation system assuring the customer has incentive dollars while installations are completed.

The CPUC with the MECT and Residential Retrofit Evaluation Team determined that the high-impact measure groups for the SDGE3017 program's verification effort are residential interior lighting, residential water heating, residential water heating controllers, and residential interior

screw lighting.³⁴ Program achievements reported through Q4 2007 for the high-impact measures are presented in Table 61.

Table 61. SDGE3017 Program Claims (2006-2007)³⁵

Measure Description	Quantity
Res Interior Lighting	118,945
Res Interior Screw Lighting	123,498
Res Water Heating*	24,174
Res Water Heating Controllers	218

Installation Verification Sampling and Methodology

Verification Priorities

Four of the SDGE3017 multifamily program measure groups are considered high-impact, as described above. Data collection for the verification of these high-impact measures was based upon sample sizes selected to yield verification results with 10-percent precision at the 90-percent confidence level at the program level. Additionally all research and data collection effort designed to minimize any potential biases.

Participant Surveys

Participant phone surveys were used to recruit sites for on-site verification. The recruitments were conducted with a randomly selected sample of program participants who installed one or more of the high-impact measures. The population that installed either of the two lighting measures or the water heating measures was large enough to be able to randomly select a sample that achieved the 90/10 confidence/precision goal. The water heater controller population was not large enough to draw a random sample, since there were only 39 unique sites that installed water heater controllers in SDG&E's territory. Thus the Residential Retrofit Evaluation Team attempted to contact all of these sites to get as many as possible to agree to an on-site visit.

Table 62 provides the number of unique sites where high-impact measures were installed and on-site verification visits were conducted. The on-site verification sample was selected from the sample of completed phone surveys. Phone surveys were conducted for recruitment for the site visits only and not part of the verification process.

³⁴ The verified residential water heating measures were limited to faucet aerators and low flow shower heads.

³⁵ per Q4 2007 E3 Calculator.

Site Visits

To validate installation of energy efficiency measures listed in program tracking data, site visits were conducted on a selected sample of participants from the HIM groups. The on-site sample sizes for each high-impact measure were calculated using a sampling algorithm that combined the number of unique sites where the measure was installed with the desire for results with 10-percent precision at the 90-percent confidence level. Site visit participants were recruited during phone survey efforts. Table 62 provides detail on the site visit sample sizes.³⁶

Table 62. SDGE3017 Sample Sizes

Utility	High Impact Measure Group	Participating Multifamily Sites (Through 4Q 2007)**	Site Visits**
SDG&E	Res Interior Lighting	631	70
SDG&E	Res Interior Screw Lighting	314	57
SDG&E	Res Water Heating	326	52
SDG&E	Res Water Heating Controllers	39	6

* A multifamily site is a multifamily complex

** The number of multifamily sites visited to verify the high-impact measure groups. For many sites, more than one measure was verified.

Verification of Program Installations

The multifamily verification effort used on-site visits to determine if the rebated interior lighting fixtures, interior screw-in CFLs, residential faucet aerators and low flow shower heads, and water heater and boiler control measures were installed and operational. The Residential Retrofit Evaluation Team verified the installation of measures reported in the utility's tracking databases and compared the quantity installed at each site with the quantity recorded in the database. For most sites, the Residential Retrofit Evaluation Team verified all common area measures and verified a sub-sample of apartment measures installed at a multifamily site. In cases where only a sub-sample was verified, the verification percentage observed in the sub-sample was weighted by the number of measures reported as incented from the tracking data to determine a site-level verified quantity³⁷.

As noted in Table 63, on the following page, results from the 70 multifamily interior lighting site visits showed that 6.55 percent of the interior lighting fixtures could not be verified as installed and operational. Of the 25,269 interior lighting fixtures that were list on the tracking data for the

³⁶ A site is defined as a multifamily complex. In most cases multiple installations of high efficiency measures were verified at each site.

³⁷ In general, the on-site verification team attempted to gain access to 10 treated dwelling at larger sites. If the number of treated sites was less than or equal to 4 dwellings, the team attempted to enter all treated dwellings. The number of dwelling actually verified at each site depended largely upon the cooperation of tenants and the site management.

70 sites, 1,656 of these lights were no longer installed or operating.³⁸ An on-site survey adjustment rate of 93.45 percent was achieved for SDG&E's interior lighting fixture measures. A verification rate below 100 percent for interior lighting fixtures was found, either because the rebated fixtures were never installed and the original fixtures were still in place or the rebated fixtures had been replaced by other lighting fixtures (such as ceiling fans, candelabras, and vanity fixtures with incandescent bulbs) and, therefore, the rebated fixtures could not be located. In some cases, property managers and tenants said the rebated fixtures were burning out, which resulted in a replacement of fixtures.

Table 63. SDGE3017 On-Site Verification Findings

	On-Site Survey	Total Survey Adjustment
Residential Interior Lighting (n=70)		
% of units currently installed/operable	93.45%	93.45%
% of units not installed/operable/operable	6.55%	NA
Residential Interior Screw Lighting (n=57)		
% of units currently installed/operable	61.38%	61.38%
% of units not installed/operable/operable/operable	38.62%	NA
Residential Water Heating (n=52)		
% of units currently installed/operable	58.92%	58.92%
% of units not installed/operable/operable/operable	41.08%	NA
Residential Water Heater Controllers (n=24)		
% of units currently installed/operable	100.0%	100.0%
% of units not installed/operable/operable/operable	0.0%	NA

The site verification visits included 57 multifamily sites with interior screw lighting. At the 57 multifamily sites 35,490 screw based lighting measures were listed on the tracking data. The on-site visits found that 38.62 percent of the tracking quantities could not be verified as installed and operational, or 13,706 measures were not currently installed and operational. An on-site survey adjustment rate of 61.38 percent was achieved for SDG&E's interior screw based lighting measures.

A verification rate below 100 percent for interior screw-in lighting fixtures is not completely unexpected as rebated bulbs may fail or burn out before on-site visits are conducted. Some of the reasons for the relatively low verification rate for interior screw-in lighting stem from the replacement of rebated CFLs with CFL bulbs purchased from other locations (such as home improvement and hardware stores) due to bulb burnout or failure, replacement of CFLs with incandescent bulbs due to the preferences of the tenants regarding lighting, and missing lamps

³⁸ The verification effort attempted a census of common area measures and a subsample of measures installed in dwelling units. The site level, measure specific verification rate was then multiplied by the site and measure specific tracking quantity to determine the number of units currently installed and operational at the site. This approach was used in the verification of all four high-impact measure groups.

altogether. Property managers at some of the multifamily locations stated that the tenants are responsible for changing failed lamps and therefore the rebated lamps may not be present and/or may have been replaced with incandescent bulbs (or fewer bulbs than the fixture was made to hold). Managers also mentioned that lamps may be missing because tenants take them when they move out.

Table 63 also lists the results for the 52 multifamily water heating site visits. The water heating site visits verified the installation and operation of faucet aerators and low flow shower heads. The on-site visits found that 41.08 percent of the water heating measures could not be verified. Of the 4,705 measures listed on the tracking data for the 52 sites, the verification percentage implies that only 2,774 measures were installed and operational while 1,931 measures were not currently installed. Reasons cited for a verification rate of less than 100 percent for water heater measures stem from the replacement of the low flow showerheads and faucet aerators by tenants and/or property managers due to the installation of water filtration systems on sink faucets, the installation of new sinks and faucets that did not have aerators, and possible problems with clogging of the aerators. Non-rebated water heating measures with higher water flow rates were also observed in place of the rebated measures, suggesting that tenants and/or property managers made these changes to improve water pressure. An on-site survey adjustment rate of 58.92 percent was achieved for SDG&E's water heating measures.

The site visits included 6 multifamily sites with residential water heater or boiler controls. The tracking data for the 6 sites indicated that 24 water heater control measures had been installed. The on-site verification team found 24 measures installed and operational. An on-site survey adjustment rate of 100 percent was achieved for SDG&E's water heater control measures.

3.15. SDGE3028 Appliance Recycling Program

Program Overview

The Appliance Recycling program (ARP) seeks to produce cost-effective, long-term, coincident peak demand reduction and annual energy savings in residential and nonresidential market sectors by removing operable, inefficient, primary and secondary refrigerators, freezers, and room air conditioners from the power grid in an environmentally safe manner. To stimulate participation, ARP offers incentives for eligible refrigerators (\$35), freezers (\$35), and room air conditioners (\$25). In addition, ARP collaborates with other utility programs such as the Residential Energy Efficiency Incentive program and Multifamily Energy Efficiency Rebate program. These programs help encourage ARP participants to replace retired units with ENERGY STAR-qualified refrigerators, freezers, and room air conditioners.

The 2006–2008 program included two significant changes to previous program iterations: the addition of room air conditioners and expanding eligibility to include small commercial businesses. The ARP added room air conditioners at the suggestion of the program Advisory Group (PAG), based on market saturation and potential for additional cost-effective, long-term, coincident peak demand reduction, and long-term, annual energy savings. The addition of room air conditioners complements the existing ARP portfolio and supplements the ENERGY STAR-qualified room air conditioner rebate offered through other utility programs. Implementation of room air conditioners follows the best practice model established through the Keep Cool Bounty

program of New York State Energy Research and Development Authority (NYSERDA). Also, as a number of office complexes and industrial buildings have standard, residential-size refrigerators and freezers, the PAG recommended expanding the 2006-2008 ARP. In response, the program now offers incentives to select nonresidential customers, including office complexes, industrial customers, schools, and municipalities.

The CPUC and project team evaluators determined that two of SDGE3028 program's three measures, refrigerator and freezer recycling, are high-impact program measure groups for the SDG&E verification effort. Program achievements reported through Q4 2007 for these two high-impact measures are presented in Table 64.

Table 64. SDGE3028 Program Claims (2006-2007)³⁹

Measure Description	Quantity
Recycle Refrigerator	20,162
Recycle Freezer	3,349

Installation Verification Sampling and Methodology

Verification Priorities

As noted above, two of the three ARP customer-rebated measures were considered high-impact combinations: refrigerator and freezer recycling. Consequently, data collection for the verification of these measures was based upon sample sizes selected to yield verification results with 10-percent precision at the 90-percent confidence level at the program level and a research and data collection design to minimize any potential biases.

Participant Surveys

To verify program-incented measure removal, the phone survey was based upon a randomly selected sample of program participants and stratified by program measure.

Participants that had an older refrigerator and freezer recycled were asked questions regarding whether the unit was removed from their home, the program's role in the decision to remove the unit, the usage patterns of the removed appliance, and participation in other related SDG&E programs.⁴⁰ No site visits were conducted as part of this verification effort. See Table 65, on the following page, for the detailed sample size and stratification of the telephone surveys.

³⁹ per Q4 2007 E3 Calculator..

⁴⁰ The first of these is the inquiry used for the verification analyses. The others will be used for the impact evaluation.

Table 65. SDGE3028 Sample Sizes

Measure	Participants* (Through 4Q 2007)	Telephone Surveys	Site Visits
Recycle Refrigerator	19,207	234	NA
Recycle Freezer	3,303	82	NA

*Note participants are defined as households recycling at least one appliance, not the recycled unit itself.

Installation Results

Table 66 and Table 6 on the following page present results from telephone surveys for recycled refrigerators and freezers. Telephone survey results for both recycled refrigerators and freezers revealed that all program measures were removed for a verification rate of 100 percent.

Table 66. SDGE3028 Verification Findings for Recycled Refrigerators

	Phone Survey (N=234)	On-site Survey* (N=0)	Total Survey Adjustment**
% of units confirmed as removed	100.0% (234)	NA	100.0%
% of units not confirmed as removed	0.0% (0)	NA	NA

*No site visits conducted, recognizing that a site visits provides no greater accuracy as it is not possible to confirm on-site that a unit was previously there and then removed.

**Realization rate is the product of the % of units currently installed/operable from the phone survey and the on-site surveys

Table 6. SDGE3028 Verification Findings for Recycled Freezers

	Phone Survey (N=82)	On-site Survey* (N=0)	Total Survey Adjustment**
% of units confirmed as removed	100.0% (82)	NA	100.0%
% of units not confirmed as removed	0.0% (0)	NA	NA

*No site visits conducted, recognizing that a site visits provides no greater accuracy as it is not possible to confirm on-site that a unit was previously there and then removed.

**Realization rate is the product of the % of units currently installed/operable from the phone survey and the on-site surveys

3.16. SDGE3035 Comprehensive Manufactured / Mobile Home program

Program Overview

The Comprehensive Manufactured-Mobile Home program (CMMHP) seeks to produce cost-effective, long-term, coincident peak demand reduction and annual energy savings in the residential market sector. The program installs or performs as many of the following measures and activities as possible in existing manufactured homes: duct test and seal, AC diagnostic and tune-up, Compact Fluorescent Lamps (CFLs), faucet aerators, low-flow showerheads, CFL hardwire fixtures, and efficiency upgrades to common area lighting (CFL bulbs and fixtures) in manufactured home parks. The AC measure consists of a check on refrigerant charge and airflow, which is why other programs often refer to this measure as RCA.

To stimulate participation, CMMHP measures are installed free of charge. The program provides general information on energy efficiency to manufactured home residents and specific information about the measures installed in their homes. Each customer receives an energy efficiency tips brochure that also teaches about other energy efficiency programs, and provides phone numbers and contact information for those interested.

The program implementer, American Synergy Companies (ASC), delivered this program for SDGE in 2006-2008. American Synergy delivered a similar program in the PG&E, SCE, and SDG&E service territories.

The CPUC and project team evaluators determined that the SDGE3035 program's duct test and seal and AC diagnostic measures are high-impact program measure groups for the SDG&E verification effort. Program achievements reported through Q4 2007 for these two high-impact measures are presented in Table 68.

Table 68. SDGE3035 Program Claims (2006-2007)⁴¹

Measure Description	Quantity
Duct Test and Seal	2,535
AC Diagnostic	4,032

⁴¹ per Q4 2007 E3 Calculator.

Installation Verification Sampling and Methodology

Verification Priorities

Two of the CMMHP-installed measures when taken together are identified as a high-impact measure group: duct test and seal, and AC diagnostic tune-up. Consequently, data collection to verify these measures was based upon sample sizes selected to yield verification results for the measure group with 10-percent precision at the 90-percent confidence level at the program level, and with a research and data collection process designed to minimize any potential biases.

Participant Surveys

To verify program-incented measure installation, the phone survey was based on a randomly selected sample of program participants and stratified by the two HVAC program measures.

Participants sign up to have their homes treated by the program implementer with every measure expected to produce savings. In the phone survey, participants were asked to confirm the HVAC measure(s) were installed; whether other program measures were still installed and operating; what role the program played in their decision to have the HVAC measure installed.⁴² Table 69 provides more detail on telephone survey sample size and stratification.

Site Visits

To validate the results of the telephone survey results, site visits were conducted on a sample of participants in the duct test and seal or AC diagnostic measures. The site visit participants were recruited during phone survey efforts. This table also provides detailed site visit sample sizes.

Table 69. SDGE3035 Sample Sizes

Measure	Participants ¹ (Through 4Q 2007)	Telephone Surveys	Site Visits ²
Duct Test and Seal	2,535	82	43
AC Diagnostic	4,032	137	68

¹ Total participants receiving each measure are shown. Since many participants received both of these HVAC measures, the number of unique program participants is less than the sum of these two counts.

² In 2008, 75 site visits were conducted but 36 of these had both HVAC measures.

Installation Results

Table 70 and Table 71, on the following page, present results from telephone and on-site surveys for the HVAC measures (duct test and seal and AC diagnostic and tune-up). Survey respondents reported that the duct work had been completed at all homes for a verification rate of 100 percent. Of those that received the AC measure, all but one were able to verify that they had received the measure for a verification rate of 99.3 percent (136/137).

⁴² The first inquiry is part of this verification effort. The latter two are collected for use in the evaluation effort.

On-site inspections also found that duct and AC work had been completed in the participant homes. However, the technicians' ability to verify the two high-impact measures was limited due to the nature of those measures. In practice, verification was based on the limited physical evidence that a measure had been implemented, supplemented by the participant's recollection of the work performed. The physical evidence—consisting of stickers on AC units and some evidence ducts had been sealed—only serves to demonstrate something may have been done. The measurable physical characteristics, such as duct leakage and refrigerant charge, were not verifiable by the visual inspections.

Table 70. SDGE3035 Verification Findings for Duct Test and Seal

	Phone Survey (N=82)	On-site Survey* (N=43)	Total Survey Adjustment**
% of units currently installed/operable	100.0% (82)	100.0% (43)	100.0%

* The site visit participants were recruited during phone survey efforts, thus are a subset of the telephone survey participants.

**Realization rate is the product of the % of units currently installed/operable, from the phone survey and the on-site surveys.

Table 71. SDGE3035 Verification Findings for AC Diagnostic and Tune-up

	Phone Survey (N=137)	On-Site Survey* (N=68)	Total Survey Adjustment**
% of units currently installed/operable	99.3% (136)	100.0% (68)	99.3 %
Measure could not be verified	0.7% (1)	NA	NA

* The site visit participants were recruited during phone survey efforts, thus are a subset of the telephone survey participants.

**Realization rate is the product of the % of units currently installed/operable, from the phone survey and the on-site surveys.

3.17. SDGE3024 Residential Incentive Program

Program Overview

The SDGE3024 Residential Incentive program (RIP) is designed to provide the residential market, including owners and renters of single-family homes, condominiums, mobile homes, and attached homes up to four-plex, with incentives to purchase high efficiency appliances and home equipment. The program offered rebates for pool pumps and motors, whole house fans, storage water heaters, attic and wall insulation, ENERGY STAR® refrigerators, dishwashers, central natural gas furnaces, and room air conditioners.

In addition to traditional mail-in rebates, RIP utilized a point-of-sale (POS) rebate delivery method for some measures. POS rebates offer instant incentive discounts for selected energy-efficient products. Furthermore, customers are able to participate without having to complete and mail-in a rebate application. The program established relationships with retailers who agreed to stock qualifying products and were reimbursed for the rebates by the utility. This method simplified participation for consumers, thus increasing participation levels. Customers purchasing qualifying products from a non-participating retailer still had the option of submitting a mail-in rebate application.

RIP coordinated efforts with SDG&E's education and outreach programs to inform customers on best practices for the home. Financial incentives were included to encourage customers to install energy efficient appliances and equipment. In addition to offering information and incentives to customers, the program expects that retailers will become more inclined to stock energy-efficient products as demand increased.

In addition to achieving specific participation goals for each measure and annual energy savings goals, RIP:

- Linked incentives for the purchase of new equipment to recycling opportunities. The program sought to accelerate the increase in market share by facilitating consumer purchase of new units and the removal and permanent retiring of old, inefficient units.
- Expanded 2006-2008 POS activities to include new measures and retailers.
- Provided customer education concerning the benefits of energy efficiency to create demand for higher efficiency products.
- Visited retailers to provide personal training and information to sales associates and post-rebate signage.
- Coordinated rebates for clothes washers through the County Water Authority partnership, and cross-promoted the Energy Loan program offered through Viewtech Financial Services.

The CPUC and project team evaluators determined that the SDGE3024 program's pool pump single- and multi-speed motors and pool pump reset agreements are high-impact program measure groups for the SDG&E verification effort. Program achievements reported through Q4 2007 for these three high-impact measures are presented in Table 72, on the following page.

Table 72. SDGE3024 Program Claims (2006-2007)⁴³

Measure Description	Quantity
Pool pump - single-speed	682
Pool pump - multi-speed	200
Pool pump Reset	6,854

To be eligible for the single- or multi-speed pump rebate, SDG&E customers had to purchase an efficient pool pump that was included on the qualifying model list. In order to qualify for the pool pump reset agreement rebate, SDG&E customers had to meet four conditions:

- Swimming pool must be in-ground (spas and above-ground pools do not qualify)

⁴³ per Q4 2007 E3 Calculator.

- Did not participate in the single-speed pool pump rebate program in 2005
- Currently filter during peak times between noon and 6:00 p.m.
- During the off-season (October-April), able to reduce daily filtering time by at least one hour

If the above four conditions were met, then the applicant was asked to agree to reduce daily filtering time by at least one hour during the off-season (October 1-April 30) and to reset the pool filtering time clock to run before noon or after 6:00 p.m. (year-round).

Installation Verification Sampling and Methodology

Verification Priorities

Three of the RIP end-use customer-rebated measures were considered high-impact combinations: single-speed pool pumps, multi-speed pool pumps, and the pool pump reset agreement. Consequently, data collection for the verification of these measures was based upon sample sizes selected to yield verification results with 10-percent precision at the 90-percent confidence level at the program level and a research and data collection design to minimize any potential biases.

Participant Surveys

To verify program-incented measure installation, the phone survey was based upon a randomly selected sample of program participants and stratified by program measure.

Participants that purchased efficient pool pumps were asked questions regarding whether the unit was still installed and operating, the program's role in the decision to purchase the unit, whether the unit was a replacement, time of use, efficiency of the original, and participation in other related SDG&E programs. Participants that signed the reset agreement were asked questions about the time of use for their pool pumps before and after program participation. See Table 73 for the detailed sample size and stratification of the telephone surveys.

Site Visits

To validate the results of the telephone survey, site visits were also conducted on a selected sample of participants in the pool pump "pumps and motors" and time clock reset agreement. The site visit participants were recruited during phone survey efforts. See Table 73, on the following page, for detailed sample size of site visits.

Table 73. SDGE3024 Sample Sizes⁴⁴

Measure	Participants (Through 4Q 2007)	Telephone Surveys	Site Visits
Pool pump Single-Speed	682	131	18
Pool pump Multi-Speed	200	30	14
Pool pump Reset	6,854	179	15

Installation Results

The telephone and on-site verification for the pool pump motor replacement measures (single-speed and multi-speed) are straight-forward and answer the following questions:

- Did the participant install the product?
- Is it operating?
- Was the product part of the qualifying list for the program?

However, the verification of the pool pump reset agreement is less straight-forward, as there is no actual product to verify. Because of this disconnect, we will review each of these separately.

Single- and Multi-Speed Pool Pump

Table 74 and Table 75 present results from telephone and on-site surveys for single-speed and multi-speed pool pump/motor measures. Telephone survey results for the multi-speed pump rebate program revealed that all program measures were installed and operating for a verification rate of 100 percent. Results for the single-speed rebate phone survey showed that two units (1.6 percent) were no longer installed or operating. On-site inspection of the single-speed and multi-speed pool pumps confirmed that all of those that said the pumps were installed and operating properly were in fact doing so (100 percent confirmation of the telephone survey responses).

Table 74. SDGE3024 Verification Findings for Pool Pump Single-Speed Motors

	Phone Survey (N=131)	On-site Survey* (N=18)	Total Survey Adjustment**
% of units currently installed/operable/operable	98.4% (129)	100.0% (18)	98.4%
% of units not installed/operable/operable/operable	1.6% (2)	0.0% (0)	NA
Motor failed – replaced with less efficient	0.8% (1)	NA	NA
Recycled product	0.8% (1)	NA	NA

* The site visit participants were recruited during phone survey efforts and thus are a subset of the telephone survey participants.

**Realization rate is the product of the % of units currently installed/operable/operable from the phone survey and the on-site surveys

⁴⁴ The site visit participants were recruited during phone survey efforts and thus are a subset of the telephone survey participants.

Table 75. SDGE3024 Verification Findings for Pool Pump Multi-Speed Motors

	Phone Survey (N=30)	On-Site Survey* (N=14)	Total Survey Adjustment**
% of units currently installed/operable/operable	100.0% (30)	100.0% (14)	100.0%
% of units not installed/operable/operable/operable	0.0% (0)	0.0% (0)	NA

* The site visit participants were recruited during phone survey efforts and thus are a subset of the telephone survey participants.

**Realization rate is the product of the % of units currently installed/operable/operable from the phone survey and the on-site surveys

Pool Pump Reset Agreement

The unique nature of the pool pump reset agreement requires additional analysis beyond simply verifying the installation of a physical product in order to estimate savings. Savings from the pool pump reset program are generated from two actions:

- Participants agree to reduce daily filtering time by at least one hour during the off-season (October 1-April 30)
- Participants, who must already be filtering during peak times between noon and 6:00 p.m. to qualify for the program, agree to reset the pool filtering time clock to run before noon or after 6:00 p.m. (year-round)

The first action reduces the hours of use of the pool pump resulting in energy savings (kWh), while the second action shifts use to off-peak periods resulting in demand savings (kW). The analysis for each of these actions is presented below.

Reduction in Hours of Use (Energy Savings - kWh)

One of the four requirements to receive the rebate, as stated in the reset agreement, required participants to reduce total runtime of the pump during the offseason (October-April) for at least one hour. According to results from the phone survey, participants reported a mean reduction time of slightly less than three-quarters of an hour in the offseason.⁴⁵

The results from the phone survey, however, differed substantially with results from a random sample of pump reset agreement rebate form applications. A random sample of 70 rebate forms showed participants claimed a mean pump runtime of 4.6 hours before the program and exceeded the one-hour reduction requirement by pledging a mean cut in pump runtime of two and a quarter hours.

⁴⁵ Although reducing peak season (May – September) runtime was not part of the agreement, survey respondents reported that they actually did reduce peak season usage by approximately one hour. This could reflect confusion regarding the requirements of the Program.

In addition, on-site visit results showed mean runtimes for pool pumps were 3.3 hours for participants of the reset agreement, whereas runtimes for non-participants (pool pump motor participants) averaged 5 hours. Although the on-site visits were conducted during the peak months, when participants were not required to reduce their hours of use, respondents to the telephone survey had reported a reduction in use by approximately one hour a day. The recorded hours of use, at 3.3 hours a day, imply that participants had, in fact, reduced the hours of use according to the agreement, and possibly even beyond the one hour a day requirement.

Load Shifting (Demand Savings - kW)

As clearly outlined in the rebate application, pool pump reset participants had to be running their pumps during peak hours (12:00 – 6:00 p.m.) and agree to not run during peak from that point forward to qualify for the rebate. There are two potential instances where participants should be disqualified: if the participant was not running during peak before the agreement or if the participant continued to run during peak after signing the rebate agreement. Each of the two potential disqualifications will be discussed below.

To investigate if participants were running pool pumps during peak periods before the program, the Residential Retrofit Evaluation Team examined the results of the telephone surveys, site visits to non-reset participant homes that had pool pump motors replaced (a comparison or baseline group), and the rebate application.

Phone survey results indicated that almost three-quarters of the participants were *not* operating their pumps during peak periods before they signed up for the program (that is, they should not have qualified for the program). Table 76 details on-site visits for homes that did not participate in the reset agreement but participated in alternate pool pump measures (single- or multi-speed motors), and found that approximately 56 percent of the homes were not operating pumps during peak. Finally, a random sample of 70 original rebate applications was also reviewed, where approximately 32 percent of the respondents were not running during peak before they signed up for the program.

Table 76. Percent of Respondents (R) Not Running Peak Before Program

Disqualification	Phone Survey (n=179)	Non-participants of Reset Agreements On-Site (n=23)	Rebate Application (n=70)
% of respondents not running peak before program	72%	56%*	32%

* This value represents % of on-site visits that were not part of reset agreement but had pump times checked and found that they were not running during peak periods

The second instance where respondents should be disqualified is if they continued to operate their pumps during peak hours after signing the agreement. Table 77 details the phone survey results indicating 5 percent of respondents continued to run the pumps during peak after the program. In addition, the on-site verification survey found that approximately 8.5 percent of respondents were still running their pool pumps during peak hours, even after signing the agreement and having knowledge of an on-site verification visit. Similarly, an examination of 60 randomly selected pool pump agreements also found that 7.3 percent of participants were reporting post-participation hours of use that included on-peak hours. These participants, in other

words, had agreed not to run their pool pumps during peak hours, and by doing so were contradicting the terms of the rebate agreement.

Table 77. Percent of Respondents (R) Still Running Peak After Program

Disqualification	Phone Survey (n=179)	On-Site (n=15)	Rebate Application (n=70)
% of respondents still running peak after program	5.0%	8.5%	7.3%

To confirm that there was at least agreement between the three sources of data used for the verification report, pump runtimes were examined from the rebate form, phone surveys, and on-site verifications to ensure that participants were consistent in their reporting. Of the 15 target on-site verifications for the reset agreement, only nine had reported phone-survey pool pump runtimes. On-site survey results showed all nine had pool pump times that matched their phone surveys. Unfortunately, only one of these records existed in the sample of rebate form applications provided to the Residential Retrofit Evaluation team. This one record proved that all three sources were in agreement – the on-site, the phone, and reset rebate application form.

Appendix A: Telephone Survey Data Collection Instruments

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Appendix B: On-Site Data Collection Instruments

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Appendix C: On-Site Protocols

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Appendix D: PGE2000 HVAC Methodology

Verification Methodology

For the purpose of verification we must specify a pass-fail criteria for duct system performance and the refrigerant charge metrics, subcooling and superheat. The evaluators reviewed the program criteria, energy code criteria in Title 24, and DEER savings development for both PGE2000 HVAC high impact measures.

Duct Sealing

PG&E provides rebates only when duct sealing occurs on existing, new or replacement units and measured leakage is 15% of nominal fan flow or better.

The 2005 Title 24 Standards specify that when any component of the heating or cooling system in a residential application is replaced in certain climate zones duct sealing is required. The standards' requirements for duct leakage depend on the types of changes the ducts undergo when the system is replaced. The meaningful requirements are as follows:

- i. If the new ducts form an entirely new duct system directly connected to the air handler, the measured duct leakage shall be less than 6% of fan flow; or*
- ii. If the new ducts are an extension of an existing duct system, the combined new and existing duct system shall meet one of the following requirements:*
 - a. the measured duct leakage shall be less than 15% of fan flow; or*
 - b. The duct leakage shall be reduced by more than 60% relative to the leakage prior to the equipment having been replaced and a visual inspection shall demonstrate that all accessible leaks have been sealed; or*
 - c. If it is not possible to meet the duct sealing requirements of Subsections a. or b., all accessible leaks shall be sealed and verified through a visual inspection by a certified HERS rater.⁴⁶*

DEER contains two duct sealing measures for all residential applications: One quantifies savings of reducing leakage to outside from 40% to 12% and the other from 24% to 12%. Below is a discussion of the assumptions inherent in the DEER models.

The DEER base case for the first duct leakage measure is “40% total air leakage”(TL). Of this total, half is supply leakage. For single-story houses, 75% of the supply leakage is assumed to go to the unconditioned attic (SupLeakTO), with the remainder leaking to the

⁴⁶ 149 (b) (2) (D), 2005 Title 24 Energy Efficiency Standards

conditioned spaces (SupLeakH). Duct leakage to the conditioned spaces, while typically part of most duct loss measurements, is not actually “lost” and is treated as supply CFM for the DEER simulation. Since more of the ducts are assumed to be located within the conditioned space for a two-story house, the fraction of total supply leakage that goes to the attic is lowered to 67%.

The multifamily apartment building configuration has much less opportunity for leakage to the outside and, on average; DEER savings assume that supply air leakage to an unconditioned space is only half of the fraction assumed for single-family homes⁴⁷.

The onsite verification procedure includes both total leakage and leakage to outside tests. The ultimate passing of a unit is first analyzed as total leakage at 25Pa being less than 15 percent of nominal fan flow, calculated as 400 cfm/nominal ton. In addition, if the leakage to outside at a house pressure of 25Pa is less than 10 percent of nominal system fan flow it will be considered passing.

Refrigerant Charge and Airflow

Correct refrigerant charge is determined by measuring the amount of subcooling in the condenser for air conditioning units with a thermostatic expansion valve (TXV) and the amount of superheat in the evaporator for those with fixed orifice metering. These measured values are then compared to targets as determined by the manufacturer or the operating conditions. Typically, manufacturers publish subcooling targets for units manufactured after 1992. The majority of units manufactured before this date are not equipped with TXVs, for those that are, a standard target of 10°F can be used. Superheat targets are calculated from Table RT-2 in the 2005 Residential ACM Approval Manual using measured return air wet bulb and condenser entering air dry bulb temperatures.

The program, Title 24, and industry standard procedures are consistent for the criteria on fixed orifice metering devices. For systems with TXV, the program allows an uncertainty of plus or minus five degrees of subcooling relative to target, while industry standard, Title 24, and the verification team require plus or minus three degrees subcooling. Target superheat or subcooling values are obtained from manufacturer’s data or calculated from the 2005 Residential ACM Approval Manual and compared to actual values. The procedure for calculating actual subcooling and superheat is as follows:

1. For Non-TXV systems determine the evaporator saturation temperature ($T_{\text{evap, sat}}$) from ASHRAE saturation tables for the measured suction pressure. For TXV systems use the measured discharge pressure to determine condenser saturation temperature ($T_{\text{cond, sat}}$).
2. Calculate the Actual Superheat or Subcooling for Non-TXV and TXV systems, respectively. This is calculated as follows:

$$\text{Actual Superheat} = T_{\text{suction}} - T_{\text{evap, sat}}$$

⁴⁷ Chapter 8: Residential Weather Dependent Measures: DEER Final Report, January 2006

$$\text{Actual Subcooling} = T_{\text{cond, sat}} - T_{\text{discharge}}$$

3. Determine the Target Superheat or Subcooling for Non-TXV and TXV systems, respectively.
4. Calculate the difference between actual and target values as follows:

$$\text{Actual Superheat} - \text{Target Superheat}$$

$$\text{Actual Subcooling} - \text{Target Subcooling}$$

5. Non-TXV systems: If the absolute value of the difference is less than or equal to 5 the system is considered to be adequately charged.
 - a. If the difference is greater than 5, the system is likely undercharged.
 - b. If the difference is less than -5, the system is likely overcharged.
6. TXV systems: If the absolute value of the difference is less than or equal to 3 the system is considered to be adequately charged.
 - a. If the difference is greater than 3, the system is likely overcharged.
 - b. If the difference is less than -3, the system is likely undercharged.

Additional post-field analysis includes using the superheat and subcooling calculations along with pressure and airflow data to determine additional outcomes indicating other potential system issues such as insufficient evaporator or condenser flow, improper TXV operation, etc.

The units were also further analyzed using all data available including the measured cooling output using the airflow and temperature and humidity measurements. If units did not pass the subcooling or superheat test, but were within plus or minus ten degrees of the target and also were operating close to manufacturer reported performance conditions, the unit was treated as passing.

Under conditions when the superheat target is near zero the system is operating with a dry coil, which was somewhat common in the measured sample. For these units, the team also looked at the subcooling of the unit with a target of 10°F. Units that had a reasonable but failing value for the superheat test that passed the subcooling test were treated as passing.

The program requires airflow verification similar to Title 24. The actual temperature split between supply and return dry bulb is calculated as shown in the steps below and compared against the target split as outlined in the 2005 Residential ACM Approval Manual. The method essentially verifies that flow is greater than 350cfm/ton for a large percentage of units based on empirical data.

1. Calculate the Actual Temperature Split as follows:

$$\text{Actual Temperature Split} = T_{\text{return, db}} - T_{\text{supply, db}}$$

2. Determine the Target Temperature Split using the appropriate tables from the 2005 Title 24 Residential ACM.
3. Calculate the difference between the actual and target values as follows:

$$\text{Actual Temperature Split} - \text{Target Temperature Split}$$

4. If the absolute value of the difference is less than or equal to 3 then the system has adequate airflow.
 - a. If the difference is greater than 3, the airflow is too low.
 - b. If the difference is less than -3, it is unlikely that the airflow is too high. Most likely the capacity is low on the system.

In addition, the verification effort utilized direct flow measurements using an orifice plate flow grid and digital manometer. The flow measurement has an accuracy of plus or minus seven percent under ideal installation conditions. Therefore, the criteria are expanded to accommodate the measurement accuracy to 325 cfm/ton. In addition, most non-ideal flow measurement installations favor the measurement low. For units where the first option for installation was unfeasible in the field, the criterion was additionally lowered to 300 cfm/ton. If a unit failed direct flow measurement, but passed the temperature split method it was considered failing for airflow and was also noted as a false positive. Units where the direct flow measurement was not possible were judged based on the temperature split method and if they passed were also subject to the false positive adjustment.

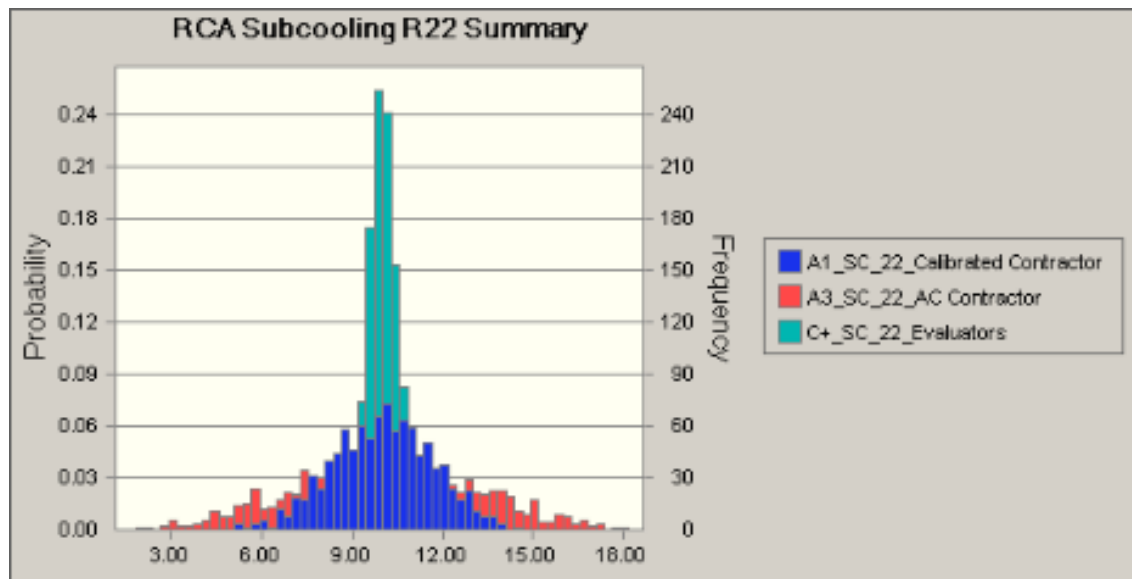
The refrigerant charge and the system airflow were equally weighted in determining the final unit disposition. Units were scored from 0 to 100 with each test worth 50 points. A unit passing both tests was scored 100 and units that failed one test but passed the other were score 50. A unit that passed the temperature split airflow test and that had indeterminate direct flow measurement was subject to the false positive adjustment and was scored 33 out of 50.

Uncertainty Analysis

The current procedure for CPUC RCA verification includes measurements of operating conditions collected by contractors and also includes instantaneous direct airflow and power measurements. The verification assessment also checks to see if refrigerant leaks are present which would rapidly degrade measure savings. The instrumentation suites for verification are manufactured and calibrated to tighter tolerances than those being used by contractors in the field. This reduction in instrumentation uncertainty should produce an independent and more accurate assessment of the appropriateness of refrigerant charge medications made by the contractors. The program evaluators ran Monte Carlo simulations to explore engineering propagation of error of the various instrumentation components required to assess superheat and subcooling which was used to inform the need and selection of improved instrumentation suites.

Essential to this study was the accuracy of the instruments used for typical refrigerant charge and airflow testing including superheat and subcooling tests. To that effect both the accuracy levels and instrument costs of several models were subject to comparison. The models of the instruments tested included calibrated instruments used by the contractors and those eventually chosen for use in the study (the evaluator). In each case it was determined that the accuracy of the instruments used by the evaluator for this study far exceeded that of the contractors. An example of these analyses is shown in Figure 1 for system with R-22 refrigerant and TXV metering device. The Figure shows that the Evaluators instrumentation suite is more likely to achieve the target of 10 degrees subcooling than instrumentation that is typically used by AC contractors and VSPs. Similar engineering propagation of error analyses were performed for PG&E by an independent third party engineer and those reports were made available to the team and have similar conclusions. The reports are not referenced directly in this report given the fact that the papers are not available to the public.

Figure 2: Monte Carlo Simulation Results for Various Instrumentation Precisions: Air Conditioner with TXV and R-22 Refrigerant



Site Visit Details

Visual inspections are insufficient to verify that HVAC performance measures have been installed properly and are producing the desired energy savings. Some methods of duct sealing leave visual evidence and those are investigated in the field but especially for the refrigerant charge measures, inspection is impossible. The verification procedures for duct sealing and RCA require similar performance diagnostic tests as those used by program implementing contractors. The verification techniques were designed to go beyond the techniques used by implementers to provide greater certainty in the measurements and to best understand energy implications of the verification results. The performance tests include additional techniques, procedures, and carefully selected precision instrumentation.

Summary of Duct Leakage Tests

Total Duct Leakage Test

To measure the HVAC system total duct leakage, a Minneapolis Duct Blaster® was used. The Minneapolis Duct Blaster® measures the amount of leakage in the duct system by pressurizing the ducts with a calibrated fan and simultaneously measuring the air flow through the fan. The duct blaster fan is connected directly to the duct system in a house, typically at a central return, or at the air handler cabinet. The remaining supply and return registers and grilles are taped off with Duct Mask temporary register seal. The duct system is then pressurized to 25 Pa in relation to the house and duct system leakage is measured using a digital pressure gauge. The test is performed at least three times to ensure reasonable and consistent measurements.

Test accuracy for the duct blaster flow calibration is $\pm 3\%$ using the DG-700 digital manometer ($\pm 1\%$).

Leakage to Outside Test

To measure the HVAC system duct leakage to outside, a Minneapolis Duct Blaster® in conjunction with the Minneapolis Blower Door™ were used. The Minneapolis Blower Door™ uses a fan and frame assembly that is temporarily sealed into an exterior doorway and the house is then pressurized to 25 Pa in relation to outside. The duct blaster fan is connected directly to the duct system in a house, typically at a central return, or at the air handler cabinet. The remaining supply registers and grilles are taped off with Duct Mask temporary register seal. The duct system is then equilibrated to the house pressure by pressurizing the ducts to 0 Pa. The fan airflow required to maintain duct pressure is the system leakage outside the thermal envelope of the home. The test is performed at least three times to ensure reasonable and consistent measurements.

Test accuracy for the blower door flow calibration is $\pm 3\%$ using the DG-700 digital manometer ($\pm 1\%$). Test accuracy for the duct blaster flow calibration is $\pm 3\%$ using the DG-700 digital manometer ($\pm 1\%$).

Summary of Refrigerant Charge and Airflow Tests

The current procedure for CPUC RCA verification includes measurements of operating conditions collected by contractors and also includes instantaneous direct airflow and power measurements. The verification assessment also checks to see if refrigerant leaks are present which would rapidly degrade measure savings. The instrumentation suites for verification are manufactured and calibrated to tighter tolerances than those being used by contractors in the field. This reduction in instrumentation uncertainty should produce an independent and more accurate assessment of the appropriateness of refrigerant charge remediation made by the contractors. The program evaluators ran Monte Carlo simulations to explore engineering propagation of error of the various instrumentation components required to assess superheat and subcooling which was used to inform the need and selection of improved instrumentation suites.

Refrigerant Charge Test

Instantaneous temperature and pressure data was captured using a digital pressure gauge and temperature sensors. The measurements taken were:

- Condenser entering dry bulb temperature
- Refrigerant liquid line temperature
- Refrigerant liquid line pressure
- Refrigerant suction line temperature
- Refrigerant suction line pressure
- Return wet bulb temperature

Pressure measurements were taken using Crystal Engineering's XP2i digital pressure gauge. OMEGA Resistance Temperature Detectors (RTDs) were used to record refrigerant line temperatures and a Vaisala H41 humidity and temperature meter measured return wet bulb temperature. Refrigerant tube surface mounting sensors are placed on the suction and liquid lines, well insulated, and held firmly in place with straps. When the unit reaches steady state, as

determined by non-changing temperature readings (normally about 10-15 minutes), simultaneous temperature and pressure readings on each line are recorded.

Test accuracy is $\pm 0.1\%$ of measurement for pressure, $\pm 1^\circ\text{F}$ for temperature, and $\pm 2\%$ for RH.

System Airflow

Two methods of measuring system airflow of residential air handlers were employed onsite: The temperature split method & orifice plate method. The temperature split method is the same method used by the program implementing contractors and therefore provides a similar metric by which to compare test results. The orifice plate method is an additional test providing reliable results over a broader range of conditions

The temperature split method uses a Vaisala H41 humidity and temperature meter to record both return & supply wet-bulb & dry-bulb temperatures. The air temperature sensors are placed in or near the center of the airstreams at points where the air is well mixed.

A TrueFlow[®] air handler flow meter was also used to measure air flow from the system fan by an orifice metering plate that is installed at the air handler cabinet or in a filter slot as close to the air handler blower as possible. Most residential systems have a filter slot at the return grille or a filter slot built into the blower compartment directly upstream of the blower. The metering plate can be installed in either of these locations. If there are multiple returns a metering plate must be installed at each one simultaneously. Once the metering plate is in place, the system fan is turned on and the entering air velocity and the exiting air velocity through the metering plate are measured to obtain fan air flow using a digital differential pressure gauge. Five readings were taken and recorded over a period of about 10 minutes.

Test accuracy is $\pm 7\%$ of flow measurement (cfm) using the DG-700 digital manometer ($\pm 1\%$). Actual accuracy can be worse if there is unknown bypass and potential flow stratification issues particularly in packaged units.

Appendix E: Excel Data Workbooks

[TO BE POSTED TO VERIFICATION REPORTING TEMPLATE]

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